PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

Assistant Commissioner for Patents
United States Patent and Trademark Office
Box PCT
Washington, D.C.20231
ÉTATS-UNIS D'AMÉRIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 06 December 1999 (06.12.99)	
International application No. PCT/AU99/00273	**Applicant's or agent's file reference** 1358PCT
International filing date (day/month/year) 14 April 1999 (14.04.99)	**Priority date** (day/month/year) 14 April 1998 (14.04.98)
Applicant LANG, Timothy et al	

1. The designated Office is hereby notified of its election made:

   [X] in the demand filed with the International Preliminary Examining Authority on:

   11 November 1999 (11.11.99)

   [ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was

   [ ] was not

   made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740 14.35

Authorized officer

Marc Salzman

Telephone No.: (41-22) 338.83.38

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF THE RECORDING OF A CHANGE

(PCT Rule 92bis.1 and Administrative Instructions, Section 422)

To:

A.P.T. PATENT AND TRADE MARK ATTORNEYS
G.P.O. Box 772
Adelaide, S.A. 5001
AUSTRALIE

Date of mailing (day/month/year)
28 September 2000 (28.09.00)

Applicant's or agent's file reference
1358PCT

IMPORTANT NOTIFICATION

International application No.
PCT/AU99/00273

International filing date (day/month/year)
14 April 1999 (14.04.99)

1. The following indications appeared on record concerning:
[X] the applicant [ ] the inventor [ ] the agent [ ] the common representative

Name and Address
ALLRAD 3 PTY. LTD.
PTI INVESTMENTS PTY LTD
Australia

State of Nationality: AU
State of Residence: AU
Telephone No.:
Facsimile No.:
Teleprinter No.:

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:
[X] the person [X] the name [X] the address [X] the nationality [X] the residence

Name and Address
FOOD INGREDIENTS TECHNOLOGIES
INTANGIBLES (BERMUDA) LIMITED
Clarendon House
Church Street
Hamilton
Bermuda

State of Nationality: **
State of Residence: **
Telephone No.:
Facsimile No.:
Teleprinter No.:

3. Further observations, if necessary:
The applicants in box (1) have assigned their rights to the new applicant in box (2).

4. A copy of this notification has been sent to:
[X] the receiving Office
[ ] the International Searching Authority
[ ] the International Preliminary Examining Authority
[ ] the designated Offices concerned
[X] the elected Offices concerned
[ ] other:

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No (41-22) 740 14 35

Authorized officer
Ellen Moyse

Telephone No.: (41-22) 338.83.38

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PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 1358PCT	**FOR FURTHER ACTION**	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416).
International application No. **PCT/AU 99/00273**	International filing date *(day/month/year)* 14 April 1999	Priority Date *(day/month/year)* 14 April 1998

International Patent Classification (IPC) or national classification and IPC

Int. Cl.[6] A23L 1/30, 1/308; A23K 1/14, 1/16; A61K 35/78

Applicant

ALLRAD 3 PTY LTD et al

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 3 sheets, including this cover sheet.

[X] This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of **13** sheet(s).

3. This report contains indications relating to the following items:

I	[X]	Basis of the report
II	[ ]	Priority
III	[ ]	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
IV	[ ]	Lack of unity of invention
V	[X]	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
VI	[ ]	Certain documents cited
VII	[ ]	Certain defects in the international application
VIII	[ ]	Certain observations on the international application

Date of submission of the demand	Date of completion of the report
11 November 1999	30 November 1999
Name and mailing address of the IPEA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized Officer **BARRY SPENCER** Telephone No. (02) 6283 2284

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/AU 99/00273

I. Basis of the report

1. With regard to the **elements** of the international application:*

☐ the international application as originally filed.

☒ the description, pages **12-20,** as originally filed,
pages **1-11,** filed with the demand,
pages , filed with the letter of .

☒ the claims, pages **23-25** , as originally filed,
pages , as amended (together with any statement) under Article 19,
pages **21, 22,** filed with the demand,
pages , filed with the letter of .

☒ the drawings, pages **1/15 -15/15,** as originally filed,
pages , filed with the demand,
pages , filed with the letter of .

☐ the sequence listing part of the description:
pages , as originally filed
pages , filed with the demand
pages , filed with the letter of .

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.
These elements were available or furnished to this Authority in the following language which is:

☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).

☐ the language of publication of the international application (under Rule 48.3(b)).

☐ the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, was on the basis of the sequence listing:

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

4. ☐ The amendments have resulted in the cancellation of:

☐ the description, pages

☐ the claims, Nos.

☐ the drawings, sheets/fig.

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).**

* *Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).*

** *Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report*

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	1-39	YES
	Claims		NO
Inventive step (IS)	Claims	1-39	YES
	Claims		NO
Industrial applicability (IA)	Claims	1-39	YES
	Claims		NO

2. Citations and explanations (Rule 70.7)

None of the citations disclose the use of fibre extracts from two or more types of fruit or vegetables wherein the fibre extracts have a majority of soluble solids removed therefrom, as a food supplement or as agents for increasing levels of fatty acids in the colon.

The claims have industrial applicability in their use as food supplements and as an agent for increasing levels of fatty acids in the colon.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU 99/00273

A. CLASSIFICATION OF SUBJECT MATTER

Int Cl[6]: A23L 1/30, 1/308; A23K 1/14, 1/16; A61K 35/78

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC AS ABOVE

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
WPAT: IPC + (FIBRE# OR FIBER#) AND (FRUIT# OR VEGETABLE#)
CASM: 17-10/SX OR /CC + INSOLUBLE FIBRE OR INSOLUBLE FIBER

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	Derwent Abstract Accession No. 98-336019, Class D13, ES, A, 2115537 (UNIV LLEIDA), 16 June 1998 Abstract	
A	J. Sci. Food Agric., v 75(3), 1997, pp 333-340, GHEYAS F *et al*, "Dietary fiber content of thirteen apple cultivars"	
A	Food Chem., v 51(1), 1994, pp 39-44, MARLETT JA *et al*, "Dietary fiber content and composition of different forms of fruits"	

☐ Further documents are listed in the continuation of Box C

☐ See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
28 May 1999	-1 JUN 1999
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200 WODEN ACT 2606 AUSTRALIA Facsimile No.: (02) 6285 3929	Authorized officer **BARRY SPENCER** Telephone No.: (02) 6283 2284

PCT

REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

For receiving Office use only

International Application No.

International Filing Date

Name of receiving Office and "PCT International Application"

Applicant's or agent's file reference *(if desired) (12 characters maximum)* 1358PCT

Box No. I TITLE OF INVENTION

FOOD SUPPLEMENT

Box No. II APPLICANT

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

ALLRAD 3 PTY LTD
C/- CORRS CHAMBER WESTGARTH
ADVANCE BANK CENTRE
60 MARCUS CLARKE STREET
CANBERRA ACT 2601
AUSTRALIA

☐ This person is also inventor.

Telephone No.: 02 94121977

Facsimile No.: 02 94139780

Teleprinter No.:

State *(that is, country)* of nationality: AUSTRALIA

State *(that is, country)* of residence: AUSTRALIA

This person is applicant for the purposes of: ☐ all designated States ☒ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

PTI INVESTMENTS PTY LTD
C/- EXFIN PTY LTD
LEVEL 3, 71 ARCHER STREET
CHATSWOOD N.S.W. 2067
AUSTRALIA

This person is:

☒ applicant only

☐ applicant and inventor

☐ inventor only *(If this check-box is marked, do not fill in below.)*

State *(that is, country)* of nationality: AUSTRALIA

State *(that is, country)* of residence: AUSTRALIA

This person is applicant for the purposes of: ☐ all designated States ☒ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

☒ Further applicants and/or (further) inventors are indicated on a continuation sheet.

Box No. IV AGENT OR COMMON REPRESENTATIVE: OR ADDRESS FOR CORRESPONDENCE

The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as: ☒ agent ☐ common representative

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

A.P.T. PATENT AND TRADE MARK ATTORNEYS
GPO BOX 772
ADELAIDE S.A. 5001
AUSTRALIA

Telephone No.: 0884105040

Facsimile No.: 0884105042

Teleprinter No.:

☐ **Address for correspondence:** Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.

EL 360627855 US

Continuation of Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

If none of the following sub-boxes is used, this sheet should not be included in the request.

Name and address: *(Family name followed by given name: for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

LANG, TIMOTHY
LEVEL 3, 71 ARCHER STREET
CHATSWOOD
N.S.W. 2067
AUSTRALIA

This person is:
- [ ] applicant only
- [x] applicant and inventor
- [ ] inventor only *(If this check-box is marked, do not fill in below)*

State *(that is, country)* of nationality: AUSTRALIA

State *(that is, country)* of residence: AUSTRALIA

This person is applicant for the purposes of:
- [ ] all designated States
- [ ] all designated States except the United States of America
- [x] the United States of America only
- [ ] the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name: for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

DENTON, ~~ERIC~~ Derek
~~800~~ ORRONG ROAD 216
TOORAK
VICTORIA 3142
AUSTRALIA

This person is:
- [ ] applicant only
- [x] applicant and inventor
- [ ] inventor only *(If this check-box is marked, do not fill in below)*

State *(that is, country)* of nationality: AUSTRALIA

State *(that is, country)* of residence: AUSTRALIA

This person is applicant for the purposes of:
- [ ] all designated States
- [ ] all designated States except the United States of America
- [x] the United States of America only
- [ ] the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name: for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

BIRD, ANTHONY R
KINTORE AVENUE
ADELAIDE
S.A. 5000
AUSTRALIA

This person is:
- [ ] applicant only
- [x] applicant and inventor
- [ ] inventor only *(If this check-box is marked, do not fill in below)*

State *(that is, country)* of nationality: AUSTRALIA

State *(that is, country)* of residence: AUSTRALIA

This person is applicant for the purposes of:
- [ ] all designated States
- [ ] all designated States except the United States of America
- [x] the United States of America only
- [ ] the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name: for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

TOPPING, DAVID
KINTORE AVENUE
ADELAIDE
S.A. 5000
AUSTRALIA

This person is:
- [ ] applicant only
- [x] applicant and inventor
- [ ] inventor only *(If this check-box is marked, do not fill in below)*

State *(that is, country)* of nationality: AUSTRALIA

State *(that is, country)* of residence: AUSTRALIA

This person is applicant for the purposes of:
- [ ] all designated States
- [ ] all designated States except the United States of America
- [x] the United States of America only
- [ ] the States indicated in the Supplemental Box

- [ ] Further applicants and/or (further) inventors are indicated on another continuation sheet.

Box No.V DESIGNATION OF STATES

The following designations are hereby made under Rule 4.9(a) *(mark the applicable check-boxes; at least one must be marked)*:

Regional Patent

- ☒ AP **ARIPO Patent:** GH Ghana, GM Gambia, KE Kenya, LS Lesotho, MW Malawi, SD Sudan, SZ Swaziland, UG Uganda, ZW Zimbabwe, and any other State which is a Contracting State of the Harare Protocol and of the PCT
- ☒ EA **Eurasian Patent:** AM Armenia, AZ Azerbaijan, BY Belarus, KG Kyrgyzstan, KZ Kazakhstan, MD Republic of Moldova, RU Russian Federation, TJ Tajikistan, TM Turkmenistan, and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT
- ☒ EP **European Patent:** AT Austria, BE Belgium, CH and LI Switzerland and Liechtenstein, CY Cyprus, DE Germany, DK Denmark, ES Spain, FI Finland, FR France, GB United Kingdom, GR Greece, IE Ireland, IT Italy, LU Luxembourg, MC Monaco, NL Netherlands, PT Portugal, SE Sweden, and any other State which is a Contracting State of the European Patent Convention and of the PCT
- ☒ OA **OAPI Patent:** BF Burkina Faso, BJ Benin, CF Central African Republic, CG Congo, CI Côte d'Ivoire, CM Cameroon, GA Gabon, GN Guinea, ML Mali, MR Mauritania, NE Niger, SN Senegal, TD Chad, TG Togo, and any other State which is a member State of OAPI and a Contracting State of the PCT *(if other kind of protection or treatment desired, specify on dotted line)* .....

National Patent *(if other kind of protection or treatment desired, specify on dotted line)*:

- ☒ AL Albania
- ☒ AM Armenia
- ☒ AT Austria
- ☒ AU Australia
- ☒ AZ Azerbaijan
- ☒ BA Bosnia and Herzegovina
- ☒ BB Barbados
- ☒ BG Bulgaria
- ☒ BR Brazil
- ☒ BY Belarus
- ☒ CA Canada
- ☒ CH and LI Switzerland and Liechtenstein
- ☒ CN China
- ☒ CU Cuba
- ☒ CZ Czech Republic
- ☒ DE Germany
- ☒ DK Denmark
- ☒ EE Estonia
- ☒ ES Spain
- ☒ FI Finland
- ☒ GB United Kingdom
- ☒ GE Georgia
- ☒ GH Ghana
- ☒ GM Gambia
- ☒ GW Guinea-Bissau
- ☒ HR Croatia
- ☒ HU Hungary
- ☒ ID Indonesia
- ☒ IL Israel
- ☒ IS Iceland
- ☒ JP Japan
- ☒ KE Kenya
- ☒ KG Kyrgyzstan
- ☒ KP Democratic People's Republic of Korea
- ☒ KR Republic of Korea
- ☒ KZ Kazakhstan
- ☒ LC Saint Lucia
- ☒ LK Sri Lanka
- ☒ LR Liberia
- ☒ LS Lesotho
- ☒ LT Lithuania
- ☒ LU Luxembourg
- ☒ LV Latvia
- ☒ MD Republic of Moldova
- ☒ MG Madagascar
- ☒ MK The former Yugoslav Republic of Macedonia
- ☒ MN Mongolia
- ☒ MW Malawi
- ☒ MX Mexico
- ☒ NO Norway
- ☒ NZ New Zealand
- ☒ PL Poland
- ☒ PT Portugal
- ☒ RO Romania
- ☒ RU Russian Federation
- ☒ SD Sudan
- ☒ SE Sweden
- ☒ SG Singapore
- ☒ SI Slovenia
- ☒ SK Slovakia
- ☒ SL Sierra Leone
- ☒ TJ Tajikistan
- ☒ TM Turkmenistan
- ☒ TR Turkey
- ☒ TT Trinidad and Tobago
- ☒ UA Ukraine
- ☒ UG Uganda
- ☒ US United States of America
- ☒ UZ Uzbekistan
- ☒ VN Viet Nam
- ☒ YU Yugoslavia
- ☒ ZW Zimbabwe

Check-boxes reserved for designating States (for the purposes of a national patent) which have become party to the PCT after issuance of this sheet:

☒ Grenada ☒ India
☒ South Africa ☒ United Arab Emirates

Precautionary Designation Statement: In addition to the designations made above, the applicant also makes under Rule 4.9(b) all other designations which would be permitted under the PCT except any designation(s) indicated in the Supplemental Box as being excluded from the scope of this statement. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit. *(Confirmation of a designation consists of the filing of a notice specifying that designation and the payment of the designation and confirmation fees. Confirmation must reach the receiving Office within the 15-month time limit.)*

Sheet No. .....

Box No. VI PRIORITY CLAIM ☐ Further priority claims are indicated in the Supplemental Box.

Filing date of earlier application (day/month/year)	Number of earlier application	Where earlier application is: national application: country	regional application:* regional Office	international application: receiving Office
item (1) 14 April 1998	PP2915	AU		
item (2)				
item (3)				

☐ The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) *(only if the earlier application was filed with the Office which for the purposes of the present international application is the receiving Office)* identified above as item(s): (1)

* *Where the earlier application is an ARIPO application, it is mandatory to indicate in the Supplemental Box at least one country party to the Paris Convention for the Protection of Industrial Property for which that earlier application was filed (Rule 4.10(b)(ii)). See Supplemental Box.*

Box No. VII INTERNATIONAL SEARCHING AUTHORITY

Choice of International Searching Authority (ISA) *(if two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used)*: ISA /

Request to use results of earlier search; reference to that search *(if an earlier search has been carried out by or requested from the International Searching Authority)*: Date *(day/month/year)* Number Country *(or regional Office)*

Box No. VIII CHECK LIST: LANGUAGE OF FILING

This international application contains the following number of sheets:

request	:	4
description (excluding sequence listing part)	:	20
claims	:	5
abstract	:	1
drawings	:	15
sequence listing part of description	:	
Total number of sheets	:	45

This international application is accompanied by the item(s) marked below:

1. ☐ fee calculation sheet
2. ☐ separate signed power of attorney
3. ☐ copy of general power of attorney; reference number, if any:
4. ☐ statement explaining lack of signature
5. ☐ priority document(s) identified in Box No. VI as item(s):
6. ☐ translation of international application into (language):
7. ☐ separate indications concerning deposited microorganism or other biological material
8. ☐ nucleotide and/or amino acid sequence listing in computer readable form
9. ☐ other *(specify)*:

Figure of the drawings which should accompany the abstract:

Language of filing of the international application:

Box No. IX SIGNATURE OF APPLICANT OR AGENT

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).

For and on behalf of ALLRAD 3 PTY LTD

Name JOHN G BROWN
Position DIRECTOR

Anthony R Bird

For and on behalf of PTI Investments Pty Ltd

Name GC NOTTLE
Position DIRECTOR

David Rodgers

Timothy Lang

Derek Denton

For receiving Office use only

1. Date of actual receipt of the purported international application:	2. Drawings: ☐ received: ☐ not received:
3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application:	
4. Date of timely receipt of the required corrections under PCT Article 11(2):	
5. International Searching Authority (if two or more are competent): ISA /	6. ☐ Transmittal of search copy delayed until search fee is paid.

For International Bureau use only

Date of receipt of the record copy by the International Bureau:

WO 99/52381
PCT/AU99/00273

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTICE INFORMING THE APPLICANT OF THE COMMUNICATION OF THE INTERNATIONAL APPLICATION TO THE DESIGNATED OFFICES

(PCT Rule 47.1(c), first sentence)

To:
A.P.T. PATENT AND TRADE MARK ATTORNEYS
G.P.O. Box 772
Adelaide, S.A. 5001
AUSTRALIE

Date of mailing (day/month/year) 21 October 1999 (21.10.99)	
Applicant's or agent's file reference 1358PCT	**IMPORTANT NOTICE**

International application No.	**International filing date** (day/month/year)	**Priority date** (day/month/year)
PCT/AU99/00273	14 April 1999 (14.04.99)	14 April 1998 (14.04.98)

Applicant
ALLRAD 3 PTY. LTD. et al

1. Notice is hereby given that the International Bureau has communicated, as provided in Article 20, the international application to the following designated Offices on the date indicated above as the date of mailing of this Notice:
   AU,CN,EP,IL,JP,KP,KR,US

   In accordance with Rule 47.1(c), third sentence, those Offices will accept the present Notice as conclusive evidence that the communication of the international application has duly taken place on the date of mailing indicated above and no copy of the international application is required to be furnished by the applicant to the designated Office(s).

2. The following designated Offices have waived the requirement for such a communication at this time:
   AE,AL,AM,AP,AT,AZ,BA,BB,BG,BR,BY,CA,CH,CU,CZ,DE,DK,EA,EE,ES,FI,GB,GD,GE,GH,GM,HR,
   HU,ID,IN,IS,KE,KG,KZ,LC,LK,LR,LS,LT,LU,LV,MD,MG,MK,MN,MW,MX,NO,NZ,OA,PL,PT,RO,RU,
   SD,SE,SG,SI,SK,SL,TJ,TM,TR,TT,UA,UG,UZ,VN,YU,ZA,ZW
   The communication will be made to those Offices only upon their request. Furthermore, those Offices do not require the applicant to furnish a copy of the international application (Rule 49.1(a-bis)).

3. Enclosed with this Notice is a copy of the international application as published by the International Bureau on
   21 October 1999 (21.10.99) under No. WO 99/52381

REMINDER REGARDING CHAPTER II (Article 31(2)(a) and Rule 54.2)

If the applicant wishes to postpone entry into the national phase until 30 months (or later in some Offices) from the priority date, **a demand for international preliminary examination** must be filed with the competent International Preliminary Examining Authority before the expiration of 19 months from the priority date.

It is the applicant's sole responsibility to monitor the 19-month time limit.

Note that only an applicant who is a national or resident of a PCT Contracting State which is bound by Chapter II has the right to file a demand for international preliminary examination.

REMINDER REGARDING ENTRY INTO THE NATIONAL PHASE (Article 22 or 39(1))

If the applicant wishes to proceed with the international application in the **national phase**, he must, within 20 months or 30 months, or later in some Offices, perform the acts referred to therein before each designated or elected Office.

For further important information on the time limits and acts to be performed for entering the national phase, see the Annex to Form PCT/IB/301 (Notification of Receipt of Record Copy) and Volume II of the PCT Applicant's Guide.

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No. (41-22) 740.14.35

Authorized officer
J. Zahra

Telephone No. (41-22) 338.83.38

EL 300027855 US

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

INFORMATION CONCERNING ELECTED OFFICES NOTIFIED OF THEIR ELECTION

(PCT Rule 61.3)

To:

A.P.T. PATENT AND TRADE MARK
ATTORNEYS
G.P.O. Box 772
Adelaide, S.A. 5001
AUSTRALIE

Date of mailing (day/month/year) 06 December 1999 (06.12.99)		
Applicant's or agent's file reference 1358PCT	**IMPORTANT INFORMATION**	
International application No. PCT/AU99/00273	**International filing date** (day/month/year) 14 April 1999 (14.04.99)	**Priority date** (day/month/year) 14 April 1998 (14.04.98)
Applicant ALLRAD 3 PTY. LTD. et al		

1. The applicant is hereby informed that the International Bureau has, according to Article 31(7), notified each of the following Offices of its election:

   AP :GH,GM,KE,LS,MW,SD,SL,SZ,UG,ZW
   EP :AT,BE,CH,CY,DE,DK,ES,FI,FR,GB,GR,IE,IT,LU,MC,NL,PT,SE
   National :AU,BG,BR,CA,CN,CZ,DE,IL,JP,KP,KR,MN,NO,NZ,PL,RO,RU,SE,SK,US

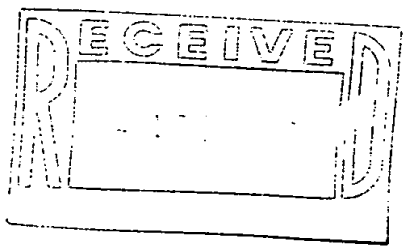
2. The following Offices have waived the requirement for the notification of their election; the notification will be sent to them by the International Bureau only upon their request:

   EA :AM,AZ,BY,KG,KZ,MD,RU,TJ,TM
   OA :BF,BJ,CF,CG,CI,CM,GA,GN,GW,ML,MR,NE,SN,TD,TG
   National :AE,AL,AM,AT,AZ,BA,BB,BY,CH,CU,DK,EE,ES,FI,GB,GD,GE,GH,GM,HR,HU,
   ID,IN,IS,KE,KG,KZ,LC,LK,LR,LS,LT,LU,LV,MD,MG,MK,MW,MX,PT,SD,SG,SI,SL,TJ,
   TM,TR,TT,UA,UG,UZ,VN,YU,ZA,ZW

3. The applicant is reminded that he must enter the "national phase" **before the expiration of 30 months from the priority date** before each of the Offices listed above. This must be done by paying the national fee(s) and furnishing , if prescribed, a translation of the international application (Article 39(1)(a)), as well as, where applicable, by furnishing a translation of any annexes of the international preliminary examination report (Article 36(3)(b) and Rule 74.1).

   Some offices have fixed time limits expiring later than the above-mentioned time limit. For detailed information about the applicable time limits and the acts to be performed upon entry into the national phase before a particular Office, see Volume II of the PCT Applicant's Guide.

   The entry into the European regional phase is postponed **until 31 months from the priority date** for all States designated for the purposes of obtaining a European patent.



The International Bureau of WIPO
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2995143

Form PCT/IB/332 (September 1997)

EL 300627855 US

The demand must be filed directly with the competent International Preliminary Examining Authority, or, if two or more Authorities are competent, with the one chosen by the applicant. The full name or two-letter code of that Authority may be indicated by the applicant on the line below:

IPEA/ _____

PCT

1358 PCT

CHAPTER II

DEMAND

under Article 31 of the Patent Cooperation Treaty:
The undersigned requests that the international application specified below be the subject of international preliminary examination according to the Patent Cooperation Treaty and hereby elects all eligible States (except where otherwise indicated).

For International Preliminary Examining Authority use only

Identification of IPEA	Date of receipt of DEMAND

Box No. I IDENTIFICATION OF THE INTERNATIONAL APPLICATION

Applicant's or agent's file reference:

International application No.	International filing date *(day/month/year)*	(Earliest) Priority date *(day/month/year)*
PCT/AU99/00273	14-04-1999	14-04-1998

Title of invention: FOOD SUPPLEMENT

Box No. II APPLICANT(S)

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

ALLRAD 3 PTY LTD
John G Brown
Brown Brothers Milawa Vineyards Pty Ltd
Milawa
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Telephone No.: 02 94121977
Facsimile No.: 02 94139780
Teleprinter No.:

State *(that is, country)* of nationality: AUSTRALIA
State *(that is, country)* of residence: AUSTRALIA

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

PTI INVESTMENTS PTY LTD
C/o Food Ingredients Technologies Australia Pty Ltd
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State *(that is, country)* of nationality: AUSTRALIA
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LANG, Timothy
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State *(that is, country)* of residence: AUSTRALIA

[X] Further applicants are indicated on a continuation sheet.

EL 300627857 US

International application No.
PCT/AU99/00273

Continuation of Box No. II APPLICANT(S)

If none of the following sub-boxes is used, this sheet should not be included in the demand.

Name and address: *(Family name followed by given name: for a legal entity, full official designation. The address must include postal code and name of country.)*

DENTON, Derek
816 Orrong Road
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(Applicant for the United States only)

State *(that is, country)* of nationality:	State *(that is, country)* of residence:
AUSTRALIA	AUSTRALIA

Name and address: *(Family name followed by given name: for a legal entity, full official designation. The address must include postal code and name of country.)*

BIRD, Anthony R
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State *(that is, country)* of nationality:	State *(that is, country)* of residence:
AUSTRALIA	AUSTRALIA

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TOPPING, David
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(Applicant for the United States only)

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AUSTRALIA	AUSTRALIA

Name and address: *(Family name followed by given name: for a legal entity, full official designation. The address must include postal code and name of country.)*

State *(that is, country)* of nationality:	State *(that is, country)* of residence:

☐ Further applicants are indicated on another continuation sheet.

International application No.
PCT/AU99/00273

Box No. III AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE

The following person is [X] agent [ ] common representative

and [X] has been appointed earlier and represents the applicant(s) also for international preliminary examination.

[ ] is hereby appointed and any earlier appointment of (an) agent(s)/common representative is hereby revoked.

[ ] is hereby appointed, specifically for the procedure before the International Preliminary Examining Authority, in addition to the agent(s)/common representative appointed earlier.

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

A.P.T. Patent and Trade Mark Attorneys
GPO Box 772
ADELAIDE
South Australia 5001
Australia

Telephone No.: 08 8410 5040

Facsimile No.: 08 8410 5042

Teleprinter No.:

[ ] Address for correspondence: Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.

Box No. IV BASIS FOR INTERNATIONAL PRELIMINARY EXAMINATION

Statement concerning amendments:*

1. The applicant wishes the international preliminary examination to start on the basis of:

[ ] the international application as originally filed

the description [ ] as originally filed
[X] as amended under Article 34

the claims [ ] as originally filed
[ ] as amended under Article 19 (together with any accompanying statement)
[X] as amended under Article 34

the drawings [X] as originally filed
[ ] as amended under Article 34

2. [ ] The applicant wishes any amendment to the claims under Article 19 to be considered as reversed.

3. [ ] The applicant wishes the start of the international preliminary examination to be postponed until the expiration of 20 months from the priority date unless the International Preliminary Examining Authority receives a copy of any amendments made under Article 19 or a notice from the applicant that he does not wish to make such amendments (Rule 69.1(d)). *(This check-box may be marked only where the time limit under Article 19 has not yet expired.)*

* Where no check-box is marked, international preliminary examination will start on the basis of the international application as originally filed or, where a copy of amendments to the claims under Article 19 and/or amendments of the international application under Article 34 are received by the International Preliminary Examining Authority before it has begun to draw up a written opinion or the international preliminary examination report, as so amended.

Language for the purposes of international preliminary examination: .....

[X] which is the language in which the international application was filed.

[ ] which is the language of a translation furnished for the purposes of international search.

[ ] which is the language of publication of the international application.

[ ] which is the language of the translation (to be) furnished for the purposes of international preliminary examination.

Box No. V ELECTION OF STATES

The applicant hereby elects all eligible States *(that is, all States which have been designated and which are bound by Chapter II of the PCT)*

excluding the following States which the applicant wishes not to elect:

See Notes to the demand form

Sheet No. 4.

International application No.
PCT/AU99/00273

Box No. VI CHECK LIST

The demand is accompanied by the following elements, in the language referred to in Box No. IV, for the purposes of international preliminary examination:

			For International Preliminary Examining Authority use only: received	not received
1. translation of international application	:	sheets	☐	☐
2. amendments under Article 34	:	27 sheets	☐	☐
3. copy (or, where required, translation) of amendments under Article 19	:	sheets	☐	☐
4. copy (or, where required, translation) of statement under Article 19	:	sheets	☐	☐
5. letter	:	1 sheets	☐	☐
6. other *(specify)*	:	sheets	☐	☐

The demand is also accompanied by the item(s) marked below:

1. [X] fee calculation sheet
2. [ ] separate signed power of attorney
3. [ ] copy of general power of attorney; reference number, if any:
4. [ ] statement explaining lack of signature
5. [ ] nucleotide and or amino acid sequence listing in computer readable form
6. [ ] other *(specify)*:

Box No. VII SIGNATURE OF APPLICANT, AGENT OR COMMON REPRESENTATIVE

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the demand).

For and on behalf of ALLRAD 3 PTY LTD

Name: JOHN S BROWN
Position: CHAIRMAN

Anthony R Bird

For and on behalf of PTI INVESTMENTS PTY LTD

Name: GC NOTTLE
Position: DIRECTOR

David Topping

Timothy Lang

Derek Denton

For International Preliminary Examining Authority use only

1. Date of actual receipt of DEMAND:

2. Adjusted date of receipt of demand due to CORRECTIONS under Rule 60.1(b):

3. ☐ The date of receipt of the demand is AFTER the expiration of 19 months from the priority date and item 4 or 5, below, does not apply. ☐ The applicant has been informed accordingly.

4. ☐ The date of receipt of the demand is WITHIN the period of 19 months from the priority date as extended by virtue of Rule 80.5.

5. ☐ Although the date of receipt of the demand is after the expiration of 19 months from the priority date, the delay in arrival is EXCUSED pursuant to Rule 82.

For International Bureau use only

Demand received from IPEA on:

FOOD SUPPLEMENT

This invention relates to a food supplement, derived from fruit or vegetable fibres, which has beneficial effects for bowel health.

BACKGROUND OF THE INVENTION

Short Chain Fatty Acids (SCFA's) are known to have significant physiological effects on the large bowel. In particular, SCFA's are considered to play a role in the protection against bowel cancer and the development of pathogenic organisms and the development of colonic ulceration and other diseases of the bowel.

SCFA's (acetate, propionate and butyrate) are produced in the large bowel by microbial fermentation. The benefits attributed to these compounds are variously thought to be the result of either reduced pH or increased levels of the molar ratios of acetate, propionate and butyrate or some combination of these. The concentration of SCFA's, pH and butyrate concentration are putative indicators of bowel health.

More particularly, butyrate is considered to offer protection against bowel cancer. As most intestinal cancers occur in the distal colon, an increased level of butyrate in this region is a key objective in controlling the incidence and development of this type of cancer.

In the processing of fruit and vegetable for consumption, a considerable amount of the fruit or vegetable remains unused because it is either unpalatable or inconvenient to use. This represents a somewhat inefficient use of resources and leads to a waste disposal problem and a loss of potentially valuable resources.

It is also desirable to have a fibre additive for foods that is a substitute, or a partial substitute for ingredients of commonly used foods substances such as flour in bread. Also desired is that these substitutes do not add to the calorific content of the foods, and in many instances that these substitutes do either not contribute flavours at all or at least do not contribute off flavours. A number of examples of fibre food additives are made from waste from fruit or vegetable processing, and one such example is the use of treated citrus albedo for inclusion of a flour substitute in various cereal products such as bread in US patent No 4526794 by Altomare et al.

DISCLOSURE OF THE INVENTION

It is a finding of this invention that the use of a mixture of fibre extracts from two or more types of fruit or vegetables can have a beneficial effect on the large bowel.

Fibre extracts from apple slices and from the albedo of oranges were extracted by a counter current method and added as a supplement to a standard feed for pigs and to a diet for humans. An unexpected increase in indicators of gut health was found when mixtures of the two fibre extracts were used when compared to the use of each fibre extract separately.

The effect is manifest in an increased production of short chain fatty acids in the large bowel, of which butyrate is the fatty acid that is increased to the greatest degree particularly in the distal colon. The experiments conducted to date are suggestive that the physiology of the large intestine is also somewhat modified in so far as the wall of the large intestine is thickened albeit by a statistically not significant amount, indicating that there may be stimulation of growth.

The term fibre in the context of this invention is intended to convey the meaning of material that is substantially indigestible in the small intestine such that it passes into the large bowel of a human or other omnivorous animal species.

It is thus proposed that in a broad form that the present invention could be said to reside in a food supplement, said food supplement derived from fibre extracts from two or more types of fruit or vegetables, the fibre extracts having had a majority of soluble solids removed therefrom.

At present the reason why such combinations of fibre extracts exert their effect is unknown, it is however thought that removal of a majority of the soluble solids is essential for this to have effect. One hypothesis is that insoluble fibre components presented in this way have a more beneficial action in promoting colonisation of beneficial bacteria in the large intestine, thereby acting as a prebiotic.

The removal of soluble solids also has the side benefit of maximising the potential value obtained from the precursor product in so far as it may be possible to sell some or all of the soluble solids. Additionally the insoluble solids that remain are more convenient for food use because they may be dried and hence put into a wider range of foods than would be possible with soluble materials. Insoluble solids from which soluble solids have been removed also have a tendency to be more stable microbiologically and not to produce off flavours, there is also the possibility that any anti microbial substances (that might

otherwise adversely affect beneficial large bowel microflora) present in parts of the fruit are also removed.

The two or more types of fruit or vegetable may be selected from the group consisting of grape, citrus, apple, tomato, carrot, mango, papaya, banana, pineapple, kiwi fruit, spinach and melon.

Preferably the two or more types of fruit or vegetables are selected from the group consisting of, grape, orange, apple, tomato, melon, cranberry and grapefruit.

In an alternative form a first of the two or more fruit and vegetables is a citrus fruit and a second fruit is selected from the group consisting of grape, apple, tomato, carrot, mango, papaya, banana, pineapple, kiwi fruit, spinach, melon and cranberry and more preferably the second fruit is selected from the group consisting of grape, apple, tomato, melon and cranberry. In one convenient form the citrus fruit is an orange.

In another alternative form a first of the two or more fruit and vegetables is an apple, and a second fruit is selected from the group consisting of grape, citrus, tomato, carrot, mango, papaya, banana, pineapple, kiwi fruit, spinach, a melon, and more preferably the second fruit is selected from the group consisting of grape, citrus, tomato, and melon.

In one specific form the fibre extracts from two fruits are used, the two fruit being orange and apple.

Citrus fruits that might be used including orange, grapefruit, tangelo, tangerine, lemon, kinnow fruit and varietals. When dealing with citrus by product parts, citrus "cups" can be used. Cups are halves of the outer portion of citrus fruits comprising the skin (flavedo) and the pith (albedo) and represent the portion of citrus fruit remaining after conventional juice extraction. Preferably the starting material for fibre extraction is a shaved skin, whereby the flavedo has been removed. The benefit of using albedo is that processing is simplified, so that the strongly flavoured portion of the skin is not included.

For pineapples, the "zenith" solids, which comprise the outer skin and inner core of pineapple can be used. Also whole pineapples can be used.

When papaya is the precursor just the flesh and skin are to be processed. When the seed is included the resultant product has a higher fibre content. Likewise mangos, without seed can be processed.

When a melon is used it might be selected from the group consisting of watermelon, rock melon, honeydew melon or champagne melon.

Without being bound by the same, a possible explanation for the beneficial effects of the combinations of fibre extracts is that the two fibre components each offer different levels of minerals, neutral non starch polysachharides and uronic acids and that a synergy is afforded by a combination of fruits or vegetables having the different levels. Soluble and insoluble neutral non starch polysaccharides, and soluble and insoluble uronic acids provide four possible substrates for microbial growth in the colon. These four possible substrates may result in a series of microbial populations being established along the large bowel, each acclimatised to a preferred substrate and each metabolising different SCFA's. In this way, the varying molar ratios of the individual SCFA's may be explained.

The high level of calcium and other elements are considered to provide beneficial effects on the proliferation of colon cells, the excretion of bile acids and avoiding mineral losses from occurring, for example with diarrhoea. Thus in the case of a mixture of orange and apple fibres, it has been determined that orange is higher in calcium, soluble neutral non starch polysaccharides and total uronic acids than is the apple. Thus it may be expected that the combination of a first fruit or vegetable having levels of one or more mineral or fibre components that are similar to orange and a second fruit or vegetable having levels comparable to apple may provide the synergistic effect. Some typical compositions of fruits are given in Table 1.

Thus in one embodiment of the invention the invention may be said to reside in a food supplement, said food supplement derived from fibre extracts from two or more types of fruit or vegetables, the fibre extracts having had a majority of soluble solids removed therefrom and wherein a first of the two or more fruits or vegetables has :

a calcium content of between 4000 and 15000 ppm;

a soluble neutral non starch polysaccharides content of between 1 and 2 percent dry weight; and

a total uronic acids content of between 5 and 20 percent dry weight

and a second of the two or more fruit or vegetables has :

a calcium content of between 200 and 1500 ppm;

a soluble neutral non starch polysaccharides content of between 2 and 3 percent dry weight; and

a total uronic acids content of between 20 and 40 percent dry weight.

Alternatively the invention may be said to reside in a food supplement derived from fibre extracts from two or more types of fruit or vegetables, the fibre extracts having had a majority of soluble solids removed therefrom and wherein a first of the two or more fruits or vegetables has a calcium content of between 4000 and 15000 ppm and a second of the two or more fruit or vegetables has a calcium content of between 200 and 1500 ppm.

Alternatively still the invention may be said to reside in a food supplement derived from fibre extracts from two or more types of fruit or vegetables, the fibre extracts having had a majority of soluble solids removed therefrom and wherein a first of the two or more fruits or vegetables has a soluble neutral non starch polysaccharide content of between 1 and 2 percent dry weight and a second of the two or more fruit or vegetables has a soluble neutral non starch polysaccharides content of between 2 and 3 percent dry weight.

As a further alternative the invention may be said to reside in a food supplement derived from fibre extracts from two or more types of fruit or vegetables, the fibre extracts having had a majority of soluble solids removed therefrom and wherein a first of the two or more fruits or vegetables has a total uronic acids content of between 5 and 20 percent dry weight and a second of the two or more fruit or vegetables has a total uronic acids content of between 20 and 40 percent dry weight.

Preferably the ratio of the first fibre extract to the second fibre extract in teh food supplement is between 1:4 and 4:1 and is most preferably between 2:3 to 3:2. In one preferred from of the invention the two fibre extracts are present in equal amounts by weight.

The invention may also be said to reside in a method of preparing a food supplement derived from fibre extracts from two or more types of fruit or vegetables, the method including the steps of removing a majority of the soluble solids from each of the two or more types of fruit or vegetables separately to give fibre extracts from the two or more fruits or vegetables, and combining the fibre extracts to provide the food supplement.

The method may include the steps of slicing each of the two or more fruits or vegetables into substantially uniform pieces, and substantially removing any remaining seed tissue from the fibre extracts after extraction an then combining the fibre extracts to provide the food supplement.

The method may also include the steps of inactivating enzymes within the fruit or vegetable pieces.

The precursor material is preferably undigested, in the sense that it has not been macerated, or treated enzymically, or by other chemical agents such as acid or alkaline to breakdown the structure of the macromolecules forming the fibres. The structure of the plant material is thus still complex. Thus when an apple is prepared for conventional pressing it is first milled, a process in which almost all of the cell walls are disrupted and in fact compounds normally isolated in cell walls or cytoplasm or vacuoles, nuclei etc are homogenised and begin to react . Many of these reactions are enzymically driven such as depolymerisation of pectin or oxidation. On the other hand when an apple is prepared by a preferred embodiment of this invention the apple is sliced, so that the longest diffusion path is no more than say 1.5mm. Slicing disrupts only a small proportion of cell walls, perhaps 0.5%, and the enzymes and their substrates are kept separate.

The method of preparing fibre also preferably includes the step of inactivating enzymes within the fruit preparation which might conveniently be by heat inactivation. Thus with the example of apple slices after slicing the slices are flash heated to a temperature at which plasmolysis occurs but no heat damage occurs to flavour compounds (60°C). This is termed a critical temperature. The resultant increase in permeability of the (still intact) cell wall increases significantly the rate of transfer of soluble solids from solid to liquid phase.

The majority of soluble solids are then removed from the precursor, by extracting liquids. This is achieved by preparing the precursor material to an appropriate size, for example by slicing to a particle with a thickness of no more than about 2 to 3 mm is found optimal for apple slices, and precontacting the precursor food material with an extraction liquid, and then separating the precursor food material from the extraction liquid, the separation occurring to an extent to give the desired reduction in soluble solids.

This extraction liquid is most preferably water, however, a non-aqueous or non-polar solvent might be used to extract water-insoluble or non-polar compounds. Examples of such solvents are, chloroform, hexane, chlorinated hydrocarbons or acetone. A specific example is the extraction of isoflavones and other flavanoids from orange peel using ethanol as the solvent.

It is preferred that water soluble solids are substantially all removed, in which case the fibre product is substantially free of sugars and other very readily soluble solids whereby greater than 90% of soluble solids are removed. One effect of this is that the fibre product is stabilised against microbial attack. That is not to say that microbial degradation of the

fibre is totally inhibited, but rather that this is reduced. Generally fungal growth is not inhibited but growth of the more common food spoiling bacteria are.

Additionally by removal of substantially all of the soluble solids the fibre product has a reduced potential for the development of an off taste, because compounds responsible for flavours have been extracted by the extraction process. Removal of substantially all of the soluble solids is intended to mean removal of substantially all soluble solids that are in a free or unbound state.

A processor suitable for extraction by counter current methods is described in Australian Patent No. 543184. Alternatively other extraction apparatus that could be used include a diffuser made by Debanske Soccerfabriker of Denmark and a diffuser made by Amos of Germany. It is anticipated that by use of these processes greater than 90% of the water soluble solids are removed, and more preferably from between 93 to 99%.

The benefits of the invention are expected largely to result by reason of fermentation in the large bowel of non-digestible components of the fruits outlined above, and it is anticipated that less purified forms of the fibres will also have a similar effect to that found for the more purified forms of fibre. It is however not desirable to use conventional techniques of expressing juice from fruit because the supplement will be high in flavours, sugars, and acids. The material is unstable microbiologically and enzymatically and will rapidly develop off flavours and odours and will quickly discolour.

In another form the invention may be said to reside in agent for increasing levels of one or more fatty acids to the colon of an animal or human wherein the agent is derived from fibre extracts from two or more types of fruit or vegetables that have had a majority of soluble solids removed therefrom. Preferably the increased level of fatty acids is greater than the level afforded by any one of the fruits or vegetables alone. Preferably also the fatty acid is a short chain fatty acid which may include acetate, propionate and butyrate. The one or more types of fruit and vegetables may be selected from the group described herein.

It will be appreciated that the invention could also reside in a food product having the food supplement. Suitable food products that may contain the food supplement include, but are not limited to, breakfast cereals, granola bars, soups and beverages including fruit juices. Preferably the food product contains between 1 and 50 % by weight of the food supplement and most preferably between 1 and 30%. In the case of liquid food products the upper limit to the amount of fibre supplement that may be added is determined by the viscoity of the ensuing product. Thus, preferably soups may contain between 2 and 15%

of teh food supplement and beverages may contain between 2 and 5 % of the food supplement.

For a better understanding the invention will now be described with reference to a number of examples. It is understood that these examples are only illustrative and are not intended to limit the scope of the invention.

DETAILED DESCRIPTION OF EXAMPLES OF THE INVENTION.

PREPARATION OF APPLE FIBRE EXTRACT

Preparation

The apples were of the Granny Smith variety from Batlow in New South Wales, Australia, and were in good condition. Apples were prepared by slicing to a 2mm thickness with a crinkle cut to provide better structural integrity.

The Counter Current Extractor (CCE)

A counter current juice extractor available from FITA of Sydney Australia was used. The method of extracting juice from fruit and vegetables using this machine is described in Australia Patent No 543184. The CCE was set up with an angle of 4.5° a short cycle time of approximately 17 seconds, a residence time of about 1 hour. Oxidation was minimal at the temperature settings recorded.

The CCE was set up with the following operation conditions:-

- feed rate 12 kg/hr
- extraction water 15 kg/hr
- angle 4.5°
- cycle time 17 seconds
  - TF time forward 9.5 sec
  - TR time reverse 7.2 sec
- RPM 3
- Temperature at recycle 63°C
- Residence time 60 minutes
- Preparation 2mm slice (Crinkle cut)
- Pool level low

Apples fed to the CCE via the slicer in 1 kg quantities at 5 minute intervals.

Extracted slices were recovered from the CCE in thoroughly cleaned plastic containers for further processing. Juice was recovered at a temperature of 18°C covered stainless steel buckets for further processing.

Fibre recovery

The fibre emerging from the CCE was collected and held for a period of about 4 hours then milled using a Fitzmill with 1/2 inch screen. This was to minimise damage to seed and skin tissue.

The fibre was then put through a paddle finisher to remove skin and seed tissue using a 40 thousandth of an inch screen where skin and seed tissue were removed. No attempt was made to dewater the fibre from this trial. When preparing fibre samples for feeding trials the seed tissue was removed but the skin tissue was not removed.

The resultant fibre was relatively free of seed tissue. The yield of fibre emerging from the CCE represented 90% of the mass of the apples entering the process. The balance (10%) represented the soluble solids extracted by diffusion.

Samples of the fibre were dried in an oven the results indicating that there was a recovery of 4.0 to 4.5% of the mass of the apples as dried fibre.

The quality of the fibre, organoleptically, was good being of pale colour and with no propensity to oxidize. It had only a very slight taste of apple which disappeared on drying, it was highly viscous (approximately 3 cm Bostwick) with strong water binding capacity.

Cleaned fibre was packed in heavy duty plastic bags in approximately 10kg quantities with a maximum thickness of 6cm. These packages were then stored at -20°C.

Yield of soluble solids in juice 92.9%. It should be noted that in commercial operation the extracted slices will be pressed to remove half their weight as water and this water (or dilute juice) is returned to the CCE as extraction liquor. Therefore yield equivalent is 96.5%. There was no evident browning of the fibre or juice emerging from the machine.

PREPARATION OF ORANGE FIBRE EXTRACT

Preparation

The peel used for this trial was from early season Valencia oranges grown in Berri in the Upper Murray district of South Australia.

Orange albedo was prepared in the following way at the Berri Fruit Juice plant at Berri, South Australia. Peel was returned from brown reamers to brown shavers where a gross separation of Albedo and Flavedo was effected. The separation was imperfect with the Albedo containing approximately 15% flavedo tissue. The two sections of peel from the shavers was packed into cardboard boxes each containing 10kg. Boxes of Flavedo and Albedo were then frozen to -20°C and transported to Sydney. Before feed to the CCE the Albedo tissue was thawed, further hand sorted to remove as much flavedo as possible and hand cut to reduce particle size (nominally 20mm x 3mm thick) using a knife.

CCE operation

The CCE was set up with the following operation conditions

- feed rate 12 kg/hr
- extraction water 15 kg/hr
- angle 7.0°
- cycle time 17 sec
  - TF time forward 9.5 sec
  - TR time reverse 7.2 sec
- RPM 3
- Temperature at recycle 75°C
- Residence time 60 minutes
- Preparation Hand slicing
- Pool level Low

Albedo tissue was fed to the CCE in 1 kg quantities at 5 minute intervals

The CCE was set up at a steep angle (7°) providing sufficient head to overcome the low porosity of the bed and the high viscosity of the extracted liquid. Relatively high temperatures were employed to minimise oxidative damage.

Fibre Handling

The extracted fibre emerging from the CCE was pressed with partial return of press liquor to increase the level of colour, then held for a period of about 2 hours at ambient temperature. Cleaned fibre was packed in heavy duty plastic bags in approximately 10 kg quantities with maximum thickness of 6cm. These packages were then stored at-18°C.

The fibre produced was of very pale yellow colour and mild bitterness but low in flavour and aroma. A small section of this was dried to constant weight in an over at 110°C. During this operation same maillard browning occurred although this was not severe and is not seen as a major barrier to commercialisation .

Juice

Yield of soluble solids in juice 75%. This yield was deliberately set as it is known that the partition coefficient for say limorin and naringim (bitter principals) between cellulose and orange juices is about 9. With higher yields of solubles unacceptable levels of bitter principals are extracted in the juice. However at a yield of 75% solubles, more than 50% of the bitter principle is carried out with the fibre.

The resultant juice was very bright but whiter in colour when compared to the spectrum of normal commercial orange products. The level of cloud was high. The juice had a viscosity of 18 cp at 12° brix and normal orange juice "mouthfeel". The juice was of good aroma and flavour with high sugar acid ratio (30:1)

PREPARATION OF CARROT AND GRAPE FIBRE EXTRACTS

The fibre extracts were prepared according to the method outlined above for the preparation of apple fibre extract.

PREPARATION OF GRAPEFRUIT FIBRE EXTRACT

The grapefruit fibre extract was prepared using the method set out above for preparation of orange fibre extract.

PREPARATION OF CRANBERRY FIBRE EXTRACT

Cranberry fibre extract is available commercially and is prepared by Ocean Spray International (Tomah, Wisconsin, USA). This extract is prepared as per the procedure outlined above except that the fibre product is reinfused with cranberry juice and marketed as sweetened dried cranberries.

COMPOSITIONAL ANALYSIS OF FIBRE EXTRACTS OR PRECURSOR FRUIT

Fibre or precursor samples were frozen until analysis. When thawed, the solids were reconstituted with juice and a homogeneous sub-sample was taken and stored at 4°C until samples were taken for analyses two hours later. A representative sample was freeze dried at between 5 and 6 millibars and at a temperature of -70°C to obtain dry matter for subsequent analyses. Following lyophilisation, the samples were milled to a mesh size of

CLAIMS

1. A food supplement, said food supplement derived from fibre extracts from two or more types of fruit or vegetables, the fibre extracts having had a majority of soluble solids removed therefrom.

2. A food supplement according to claim 1 wherein greater than 90% of soluble solids are removed.

3. A food supplement according to claim 2 wherein from between 93 to 99% of soluble solids are removed.

4. A food supplement according to claim 1 wherein a first of the two or more types of fruit or vegetables is selected from the group consisting of citrus, tomato, carrot, mango, papaya, banana, pineapple, kiwi fruit, spinach and a second of the two or more types of fruit or vegetables is selected from the group consisting of melon, grape, apple and cranberry.

5. A food supplement according to claim 4 wherein the melon is selected from the group consisting of watermelon, rock melon, honeydew melon or champagne melon.

6. A food supplement according to claim 4 wherein the first of the two or more fruit and vegetables is a citrus fruit or carrot and the second of the two or more fruit or vegetables is selected from the group consisting of grape, apple and cranberry.

7. A food supplement according to claim 6 wherein the first of the two or more types of fruit or vegetables is selected from the group consisting of orange, carrot and grapefruit and the second of the two or more types of fruit or vegetables is selected from the group consisting of grape, apple and cranberry.

8. A food supplement according to claim 1 wherein a first of the two or more fruits or vegetables has a calcium content of between 4000 and 15000 ppm and a second of the two or more fruit or vegetables has a calcium content of between 200 and 1500 ppm.

9. A food supplement according to claim 1 wherein a first of the two or more fruits or vegetables has a soluble neutral non starch polysaccharide content of between 1 and 2 percent dry weight and a second of the two or more fruit or vegetables has a soluble neutral non starch polysaccharides content of between 2 and 3 percent dry weight.

10. A food supplement according to claim 1 wherein a first of the two or more fruits or vegetables has a total uronic acids content of between 5 and 20 percent dry weight and a second of the two or more fruit or vegetables has a total uronic acids content of between 20 and 40 percent dry weight.

11. A food supplement according to claim 1 wherein
the first of the two or more fruits or vegetables has :
a calcium content of between 4000 and 15000 ppm;
a soluble neutral non starch polysaccharides content of between 1 and 2 percent dry weight; and
a total uronic acids content of between 5 and 20 percent dry weight
and the second of the two or more fruit or vegetables has :
a calcium content of between 200 and 1500 ppm;
a soluble neutral non starch polysaccharides content of between 2 and 3 percent dry weight; and
a total uronic acids content of between 20 and 40 percent dry weight.

12. A food supplement according to claim 11 wherein the first of the two or more fruit and vegetables is an orange, and the second of the two or more fruit or vegetables is selected from the group consisting of apple, grape and cranberry.

13. A food supplement according to claim 12 wherein the first of the two or more fruit and vegetables is an orange and the second of the two or more fruit or vegetables is an apple.

14. A food supplement according to claim 11 wherein the first of the two or more fruit and vegetables is a carrot, and the second of the two or more fruit or vegetables is selected from the group consisting of apple, grape and cranberry.

15. A food supplement according to claim 14 wherein the first of the two or more fruit and vegetables is a carrot, and the second of the two or more fruit or vegetables is a grape.

16. A food supplement according to claim 11 wherein the first of the two or more fruit and vegetables is a grapefruit, and the second of the two or more fruit or vegetables is selected from the group consisting of apple, grape and cranberry.

CLAIMS

1. A food supplement, said food supplement derived from fibre extracts from two or more types of fruit or vegetables, the fibre extracts having had a majority of soluble solids removed therefrom.

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3. A food supplement according to claim 2 wherein from between 93 to 99% of soluble solids are removed.

4. A food supplement according to claim 1 wherein a first of the two or more types of fruit or vegetables is selected from the group consisting of citrus, tomato, carrot, mango, papaya, banana, pineapple, kiwi fruit, spinach and a second of the two or more types of fruit or vegetables is selected from the group consisting of melon, grape, apple and cranberry.

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7. A food supplement according to claim 6 wherein the first of the two or more types of fruit or vegetables is selected from the group consisting of orange, carrot and grapefruit and the second of the two or more types of fruit or vegetables is selected from the group consisting of grape, apple and cranberry.

8. A food supplement according to claim 1 wherein a first of the two or more fruits or vegetables has a calcium content of between 4000 and 15000 ppm and a second of the two or more fruit or vegetables has a calcium content of between 200 and 1500 ppm.

9. A food supplement according to claim 1 wherein a first of the two or more fruits or vegetables has a soluble neutral non starch polysaccharide content of between 2 and 3 percent dry weight and a second of the two or more fruit or vegetables has a soluble neutral non starch polysaccharides content of between 1 and 2 percent dry weight.

10. A food supplement according to claim 1 wherein a first of the two or more fruits or vegetables has a total uronic acids content of between 20 and 40 percent dry weight and a second of the two or more fruit or vegetables has a total uronic acids content of between 5 and 20 percent dry weight.

11. A food supplement according to claim 1 wherein
the first of the two or more fruits or vegetables has :
a calcium content of between 4000 and 15000 ppm;
a soluble neutral non starch polysaccharides content of between 2 and 3 percent dry weight; and
a total uronic acids content of between 20 and 40 percent dry weight
and the second of the two or more fruit or vegetables has :
a calcium content of between 200 and 1500 ppm;
a soluble neutral non starch polysaccharides content of between 1 and 2 percent dry weight; and
a total uronic acids content of between 5 and 20 percent dry weight.

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14. A food supplement according to claim 11 wherein the first of the two or more fruit and vegetables is a carrot, and the second of the two or more fruit or vegetables is selected from the group consisting of apple, grape and cranberry.

15. A food supplement according to claim 14 wherein the first of the two or more fruit and vegetables is a carrot, and the second of the two or more fruit or vegetables is a grape.

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FOOD SUPPLEMENT

This invention relates to a food supplement, derived from fruit or vegetable fibres, which has beneficial effects for bowel health.

BACKGROUND OF THE INVENTION

Short Chain Fatty Acids (SCFA's) are known to have significant physiological effects on the large bowel. In particular, SCFA's are considered to play a role in the protection against bowel cancer and the development of pathogenic organisms and the development of colonic ulceration and other diseases of the bowel.

SCFA's (acetate, propionate and butyrate) are produced in the large bowel by microbial fermentation. The benefits attributed to these compounds are variously thought to be the result of either reduced pH or beneficial changes to the molar ratios of acetate, propionate and butyrate or some combination of these. The concentration of SCFA's, pH and in particular butyrate concentration are putative indicators of bowel health.

More particularly, butyrate is considered to offer protection against bowel cancer. As most intestinal cancers occur in the distal colon, an increased level of butyrate in this region is a key objective in controlling the incidence and development of this type of cancer.

In the processing of fruit and vegetable for consumption, a considerable amount of the fruit or vegetable remains unused because it is either unpalatable or inconvenient to use. This represents a somewhat inefficient use of resources and leads to a waste disposal problem and a loss of potentially valuable resources.

It is also desirable to have a fibre additive for foods that is a substitute, or a partial substitute for ingredients of commonly used foods substances such as flour in bread. Also desired is that these substitutes do not add to the calorific content of the foods, and in many instances that these substitutes do either not contribute flavours at all or at least do not contribute off flavours. A number of examples of fibre food additives are made from waste from fruit or vegetable processing, and one such example is the use of treated citrus albedo for inclusion of a flour substitute in various cereal products such as bread in US patent No 4526794 by Altomare et al.

DISCLOSURE OF THE INVENTION

It is a finding of this invention that the use of a mixture of fibre extracts from two or more types of fruit or vegetables can have a beneficial effect on the large bowel.

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It is also desirable to have a fibre additive for foods that is a substitute, or a partial substitute for ingredients of commonly used foods substances such as flour in bread. Also desired is that these substitutes do not add to the calorific content of the foods, and in many instances that these substitutes do either not contribute flavours at all or at least do not contribute off flavours. A number of examples of fibre food additives are made from waste from fruit or vegetable processing, and one such example is the use of treated citrus albedo for inclusion of a flour substitute in various cereal products such as bread in US patent No 4526794 by Altomare et al.

DISCLOSURE OF THE INVENTION

It is a finding of this invention that the use of a mixture of fibre extracts from two or more types of fruit or vegetables can have a beneficial effect on the large bowel.

Fibre extracts from apple slices and from the albedo of oranges were extracted by a counter current method and added as a supplement to a standard feed for pigs and to a diet for humans. An unexpected increase in indicators of gut health was found when mixtures of the two fibre extracts were used when compared to the use of each fibre extract separately.

The effect is manifest in an increased production of short chain fatty acids in the large bowel, of which butyrate is the fatty acid that is increased to the greatest degree particularly in the distal colon. The experiments conducted to date are suggestive that the physiology of the large intestine is also somewhat modified in so far as the wall of the large intestine is thickened albeit by a statistically not significant amount, indicating that there may be stimulation of growth.

The term fibre in the context of this invention is intended to convey the meaning of material that is substantially indigestible in the small intestine such that it passes into the large bowel of a human or other omnivorous animal species.

It is thus proposed that in a broad form that the present invention could be said to reside in a food supplement, said food supplement derived from fibre extracts from two or more types of fruit or vegetables, the fibre extracts having had a majority of soluble solids removed therefrom.

At present the reason why such combinations of fibre extracts exert their effect is unknown, it is however thought that removal of a majority of the soluble solids is essential for this to have effect. One hypothesis is that insoluble fibre components presented in this way have a more beneficial action in promoting colonisation of beneficial bacteria in the large intestine, thereby acting as a prebiotic.

The removal of soluble solids also has the side benefit of maximising the potential value obtained from the precursor product in so far as it may be possible to sell some or all of the soluble solids. Additionally the insoluble solids that remain are more convenient for food use because they may be dried and hence put into a wider range of foods than would be possible with soluble materials. Insoluble solids from which soluble solids have been removed also have a tendency to be more stable microbiologically and not to produce off flavours, there is also the possibility that any anti microbial substances (that might

otherwise adversely affect beneficial large bowel microflora) present in parts of the fruit are also removed.

The two or more types of fruit or vegetable may be selected from the group consisting of grape, citrus, apple, tomato, carrot, mango, papaya, banana, pineapple, kiwi fruit, spinach and melon.

Preferably the two or more types of fruit or vegetables are selected from the group consisting of, grape, orange, apple, tomato, melon, cranberry and grapefruit.

In an alternative form a first of the two or more fruit and vegetables is a citrus fruit and a second fruit is selected from the group consisting of grape, apple, tomato, carrot, mango, papaya, banana, pineapple, kiwi fruit, spinach, melon and cranberry and more preferably the second fruit is selected from the group consisting of grape, apple, tomato, melon and cranberry. In one convenient form the citrus fruit is an orange.

In another alternative form a first of the two or more fruit and vegetables is an apple, and a second fruit is selected from the group consisting of grape, citrus, tomato, carrot, mango, papaya, banana, pineapple, kiwi fruit, spinach, a melon, and more preferably the second fruit is selected from the group consisting of grape, citrus, tomato, and melon.

In one specific form the fibre extracts from two fruits are used, the two fruit being orange and apple.

Citrus fruits that might be used including orange, grapefruit, tangelo, tangerine, lemon, kinnow fruit and varietals. When dealing with citrus by product parts, citrus "cups" can be used. Cups are halves of the outer portion of citrus fruits comprising the skin (flavedo) and the pith (albedo) and represent the portion of citrus fruit remaining after conventional juice extraction. Preferably the starting material for fibre extraction is a shaved skin, whereby the flavedo has been removed. The benefit of using albedo is that processing is simplified, so that the strongly flavoured portion of the skin is not included.

For pineapples, the "zenith" solids, which comprise the outer skin and inner core of pineapple can be used. Also whole pineapples can be used.

When papaya is the precursor just the flesh and skin are to be processed. When the seed is included the resultant product has a higher fibre content. Likewise mangos, without seed can be processed.

When a melon is used it might be selected from the group consisting of watermelon, rock melon, honeydew melon or champagne melon.

Without being bound by the same, a possible explanation for the beneficial effects of the combinations of fibre extracts is that the two fibre components each offer different levels of minerals, neutral non starch polysachharides and uronic acids and that a synergy is afforded by a combination of fruits or vegetables having the different levels. Soluble and insoluble neutral non starch polysaccharides, and soluble and insoluble uronic acids provide four possible substrates for microbial growth in the colon. These four possible substrates may result in a series of microbial populations being established along the large bowel, each acclimatised to a preferred substrate and each metabolising different SCFA's. In this way, the varying molar ratios of the individual SCFA's may be explained.

The high level of calcium and other elements are considered to provide beneficial effects on the proliferation of colon cells, the excretion of bile acids and avoiding mineral losses from occurring, for example with diarrhoea. Thus in the case of a mixture of orange and apple fibres, it has been determined that orange is higher in calcium, soluble neutral non starch polysaccharides and total uronic acids than is the apple. Thus it may be expected that the combination of a first fruit or vegetable having levels of one or more mineral or fibre components that are similar to orange and a second fruit or vegetable having levels comparable to apple may provide the synergistic effect. Some typical compositions of fruits are given in Table 1.

Thus in one embodiment of the invention the invention may be said to reside in a food supplement, said food supplement derived from fibre extracts from two or more types of fruit or vegetables, the fibre extracts having had a majority of soluble solids removed therefrom and wherein a first of the two or more fruits or vegetables has :

a calcium content of between 4000 and 15000 ppm;

a soluble neutral non starch polysaccharides content of between 1 and 2 percent dry weight; and

a total uronic acids content of between 5 and 20 percent dry weight

and a second of the two or more fruit or vegetables has :

a calcium content of between 200 and 1500 ppm;

a soluble neutral non starch polysaccharides content of between 2 and 3 percent dry weight; and

a total uronic acids content of between 20 and 40 percent dry weight.

Alternatively the invention may be said to reside in a food supplement derived from fibre extracts from two or more types of fruit or vegetables, the fibre extracts having had a majority of soluble solids removed therefrom and wherein a first of the two or more fruits or vegetables has a calcium content of between 4000 and 15000 ppm and a second of the two or more fruit or vegetables has a calcium content of between 200 and 1500 ppm.

Alternatively still the invention may be said to reside in a food supplement derived from fibre extracts from two or more types of fruit or vegetables, the fibre extracts having had a majority of soluble solids removed therefrom and wherein a first of the two or more fruits or vegetables has a soluble neutral non starch polysaccharide content of between 1 and 2 percent dry weight and a second of the two or more fruit or vegetables has a soluble neutral non starch polysaccharides content of between 2 and 3 percent dry weight.

As a further alternative the invention may be said to reside in a food supplement derived from fibre extracts from two or more types of fruit or vegetables, the fibre extracts having had a majority of soluble solids removed therefrom and wherein a first of the two or more fruits or vegetables has a total uronic acids content of between 5 and 20 percent dry weight and a second of the two or more fruit or vegetables has a total uronic acids content of between 20 and 40 percent dry weight.

Preferably the ratio of the first fibre extract to the second fibre extract in teh food supplement is between 1:4 and 4:1 and is most preferably between 2:3 to 3:2. In one preferred from of the invention the two fibre extracts are present in equal amounts by weight.

The invention may also be said to reside in a method of preparing a food supplement derived from fibre extracts from two or more types of fruit or vegetables, the method including the steps of removing a majority of the soluble solids from each of the two or more types of fruit or vegetables separately to give fibre extracts from the two or more fruits or vegetables, and combining the fibre extracts to provide the food supplement.

The method may include the steps of slicing each of the two or more fruits or vegetables into substantially uniform pieces, and substantially removing any remaining seed tissue from the fibre extracts after extraction an then combining the fibre extracts to provide the food supplement.

The method may also include the steps of inactivating enzymes within the fruit or vegetable pieces.

The precursor material is preferably undigested, in the sense that it has not been macerated, or treated enzymically, or by other chemical agents such as acid or alkaline to breakdown the structure of the macromolecules forming the fibres. The structure of the plant material is thus still complex. Thus when an apple is prepared for conventional pressing it is first milled, a process in which almost all of the cell walls are disrupted and in fact compounds normally isolated in cell walls or cytoplasm or vacuoles, nuclei etc are homogenised and begin to react . Many of these reactions are enzymically driven such as depolymerisation of pectin or oxidation. On the other hand when an apple is prepared by a preferred embodiment of this invention the apple is sliced, so that the longest diffusion path is no more than say 1.5mm. Slicing disrupts only a small proportion of cell walls, perhaps 0.5%, and the enzymes and their substrates are kept separate.

The method of preparing fibre also preferably includes the step of inactivating enzymes within the fruit preparation which might conveniently be by heat inactivation. Thus with the example of apple slices after slicing the slices are flash heated to a temperature at which plasmolysis occurs but no heat damage occurs to flavour compounds (60°C). This is termed a critical temperature. The resultant increase in permeability of the (still intact) cell wall increases significantly the rate of transfer of soluble solids from solid to liquid phase.

The majority of soluble solids are then removed from the precursor, by extracting liquids. This is achieved by preparing the precursor material to an appropriate size, for example by slicing to a particle with a thickness of no more than about 2 to 3 mm is found optimal for apple slices, and precontacting the precursor food material with an extraction liquid, and then separating the precursor food material from the extraction liquid, the separation occurring to an extent to give the desired reduction in soluble solids.

This extraction liquid is most preferably water, however, a non-aqueous or non-polar solvent might be used to extract water-insoluble or non-polar compounds. Examples of such solvents are, chloroform, hexane, chlorinated hydrocarbons or acetone. A specific example is the extraction of isoflavones and other flavanoids from orange peel using ethanol as the solvent.

It is preferred that water soluble solids are substantially all removed, in which case the fibre product is substantially free of sugars and other very readily soluble solids whereby greater than 90% of soluble solids are removed. One effect of this is that the fibre product is stabilised against microbial attack. That is not to say that microbial degradation of the

fibre is totally inhibited, but rather that this is reduced. Generally fungal growth is not inhibited but growth of the more common food spoiling bacteria are.

Additionally by removal of substantially all of the soluble solids the fibre product has a reduced potential for the development of an off taste, because compounds responsible for flavours have been extracted by the extraction process. Removal of substantially all of the soluble solids is intended to mean removal of substantially all soluble solids that are in a free or unbound state.

A processor suitable for extraction by counter current methods is described in Australian Patent No. 543184. Alternatively other extraction apparatus that could be used include a diffuser made by Debanske Soccerfabriker of Denmark and a diffuser made by Amos of Germany. It is anticipated that by use of these processes greater than 90% of the water soluble solids are removed, and more preferably from between 93 to 99%.

The benefits of the invention are expected largely to result by reason of fermentation in the large bowel of non-digestible components of the fruits outlined above, and it is anticipated that less purified forms of the fibres will also have a similar effect to that found for the more purified forms of fibre. It is however not desirable to use conventional techniques of expressing juice from fruit because the supplement will be high in flavours, sugars, and acids. The material is unstable microbiologically and enzymatically and will rapidly develop off flavours and odours and will quickly discolour.

In another form the invention may be said to reside in agent for increasing levels of one or more fatty acids to the colon of an animal or human wherein the agent is derived from fibre extracts from two or more types of fruit or vegetables that have had a majority of soluble solids removed therefrom. Preferably the increased level of fatty acids is greater than the level afforded by any one of the fruits or vegetables alone. Preferably also the fatty acid is a short chain fatty acid which may include acetate, propionate and butyrate. The one or more types of fruit and vegetables may be selected from the group described herein.

It will be appreciated that the invention could also reside in a food product having the food supplement. Suitable food products that may contain the food supplement include, but are not limited to, breakfast cereals, granola bars, soups and beverages including fruit juices. Preferably the food product contains between 1 and 50 % by weight of the food supplement and most preferably between 1 and 30%. In the case of liquid food products the upper limit to the amount of fibre supplement that may be added is determined by the viscoity of the ensuing product. Thus, preferably soups may contain between 2 and 15%

of teh food supplement and beverages may contain between 2 and 5 % of the food supplement.

For a better understanding the invention will now be described with reference to a number of examples. It is understood that these examples are only illustrative and are not intended to limit the scope of the invention.

DETAILED DESCRIPTION OF EXAMPLES OF THE INVENTION.

PREPARATION OF APPLE FIBRE EXTRACT

Preparation

The apples were of the Granny Smith variety from Batlow in New South Wales, Australia, and were in good condition. Apples were prepared by slicing to a 2mm thickness with a crinkle cut to provide better structural integrity.

The Counter Current Extractor (CCE)

A counter current juice extractor available from FITA of Sydney Australia was used. The method of extracting juice from fruit and vegetables using this machine is described in Australia Patent No 543184. The CCE was set up with an angle of 4.5° a short cycle time of approximately 17 seconds, a residence time of about 1 hour. Oxidation was minimal at the temperature settings recorded.

The CCE was set up with the following operation conditions:-

- feed rate 12 kg/hr
- extraction water 15 kg/hr
- angle 4.5°
- cycle time 17 seconds
  - TF time forward 9.5 sec
  - TR time reverse 7.2 sec
- RPM 3
- Temperature at recycle 63°C
- Residence time 60 minutes
- Preparation 2mm slice (Crinkle cut)
- Pool level low

Apples fed to the CCE via the slicer in 1 kg quantities at 5 minute intervals.

Extracted slices were recovered from the CCE in thoroughly cleaned plastic containers for further processing. Juice was recovered at a temperature of 18°C covered stainless steel buckets for further processing.

Fibre recovery

The fibre emerging from the CCE was collected and held for a period of about 4 hours then milled using a Fitzmill with 1/2 inch screen. This was to minimise damage to seed and skin tissue.

The fibre was then put through a paddle finisher to remove skin and seed tissue using a 40 thousandth of an inch screen where skin and seed tissue were removed. No attempt was made to dewater the fibre from this trial. When preparing fibre samples for feeding trials the seed tissue was removed but the skin tissue was not removed.

The resultant fibre was relatively free of seed tissue. The yield of fibre emerging from the CCE represented 90% of the mass of the apples entering the process. The balance (10%) represented the soluble solids extracted by diffusion.

Samples of the fibre were dried in an oven the results indicating that there was a recovery of 4.0 to 4.5% of the mass of the apples as dried fibre.

The quality of the fibre, organoleptically, was good being of pale colour and with no propensity to oxidize. It had only a very slight taste of apple which disappeared on drying, it was highly viscous (approximately 3 cm Bostwick) with strong water binding capacity.

Cleaned fibre was packed in heavy duty plastic bags in approximately 10kg quantities with a maximum thickness of 6cm. These packages were then stored at -20°C.

Yield of soluble solids in juice 92.9%. It should be noted that in commercial operation the extracted slices will be pressed to remove half their weight as water and this water (or dilute juice) is returned to the CCE as extraction liquor. Therefore yield equivalent is 96.5%. There was no evident browning of the fibre or juice emerging from the machine.

PREPARATION OF ORANGE FIBRE EXTRACT

Preparation

The peel used for this trial was from early season Valencia oranges grown in Berri in the Upper Murray district of South Australia.

Orange albedo was prepared in the following way at the Berri Fruit Juice plant at Berri, South Australia. Peel was returned from brown reamers to brown shavers where a gross separation of Albedo and Flavedo was effected. The separation was imperfect with the Albedo containing approximately 15% flavedo tissue. The two sections of peel from the shavers was packed into cardboard boxes each containing 10kg. Boxes of Flavedo and Albedo were then frozen to -20°C and transported to Sydney. Before feed to the CCE the Albedo tissue was thawed, further hand sorted to remove as much flavedo as possible and hand cut to reduce particle size (nominally 20mm x 3mm thick) using a knife.

CCE operation

The CCE was set up with the following operation conditions

- feed rate 12 kg/hr
- extraction water 15 kg/hr
- angle 7.0°
- cycle time 17 sec
  - TF time forward 9.5 sec
  - TR time reverse 7.2 sec
- RPM 3
- Temperature at recycle 75°C
- Residence time 60 minutes
- Preparation Hand slicing
- Pool level Low

Albedo tissue was fed to the CCE in 1 kg quantities at 5 minute intervals

The CCE was set up at a steep angle (7°) providing sufficient head to overcome the low porosity of the bed and the high viscosity of the extracted liquid. Relatively high temperatures were employed to minimise oxidative damage.

Fibre Handling

The extracted fibre emerging from the CCE was pressed with partial return of press liquor to increase the level of colour, then held for a period of about 2 hours at ambient temperature. Cleaned fibre was packed in heavy duty plastic bags in approximately 10 kg quantities with maximum thickness of 6cm. These packages were then stored at-18°C.

The fibre produced was of very pale yellow colour and mild bitterness but low in flavour and aroma. A small section of this was dried to constant weight in an over at 110°C. During this operation same maillard browning occurred although this was not severe and is not seen as a major barrier to commercialisation .

Juice

Yield of soluble solids in juice 75%. This yield was deliberately set as it is known that the partition coefficient for say limorin and naringim (bitter principals) between cellulose and orange juices is about 9. With higher yields of solubles unacceptable levels of bitter principals are extracted in the juice. However at a yield of 75% solubles, more than 50% of the bitter principle is carried out with the fibre.

The resultant juice was very bright but whiter in colour when compared to the spectrum of normal commercial orange products. The level of cloud was high. The juice had a viscosity of 18 cp at 12° brix and normal orange juice "mouthfeel". The juice was of good aroma and flavour with high sugar acid ratio (30:1)

PREPARATION OF CARROT AND GRAPE FIBRE EXTRACTS

The fibre extracts were prepared according to the method outlined above for the preparation of apple fibre extract.

PREPARATION OF GRAPEFRUIT FIBRE EXTRACT

The grapefruit fibre extract was prepared using the method set out above for preparation of orange fibre extract.

PREPARATION OF CRANBERRY FIBRE EXTRACT

Cranberry fibre extract is available commercially and is prepared by Ocean Spray International (Tomah, Wisconsin, USA). This extract is prepared as per the procedure outlined above except that the fibre product is reinfused with cranberry juice and marketed as sweetened dried cranberries.

COMPOSITIONAL ANALYSIS OF FIBRE EXTRACTS OR PRECURSOR FRUIT

Fibre or precursor samples were frozen until analysis. When thawed, the solids were reconstituted with juice and a homogeneous sub-sample was taken and stored at 4°C until samples were taken for analyses two hours later. A representative sample was freeze dried at between 5 and 6 millibars and at a temperature of -70°C to obtain dry matter for subsequent analyses. Following lyophilisation, the samples were milled to a mesh size of

0.5mm. Analyses (apart from viscosity) were performed on dried and milled samples. Data for selected fruits and vegetables is shown in Table 1.

Analyses were performed as per the following methods, all of which are known in the art.

Dry Matter	Lyopholised residue
Fat (Ether Extractables)	Ether extract: AOAC 920.39
Ash	Residue from 480°C furnace
Viscocity at a shear rate of 200 sec^{-1}	Cone and Plate Method
Simple Sugars and Oligosaccharides	HPLC Method
Neutral Non Starch Polysaccharides	GC Uppsala Method
Soluble and Insoluble Uronic Acids	Dubois/Scott Method
Lignin	AOAC Official Method 994.13

PIG FEEDING TRIALS OF FIBRE EXTRACTS

Materials and Methods

Animals

A total of 28 young-adult male pigs (starting live weight = 32 kg) were chosen for experiment and maintained in individual pens with a concrete floor in a temperature-controlled room at the Pig Nutrition Research Facility (Roseworthy Campus). Pigs were obtained from the commercial piggery at the same institution.

Diets

Composition of the diets is shown in Table 2. The basal (Control) diet was formulated to be high in saturated fat (15% lipid by weight - 13% palm oil and 2% safflower oil), and marginal in calcium content (0.4%, by weight). Wheat bran was the source of dietary fibre (17% by weight, equivalent to 7.5% NSP). For treatment diets wheat bran was replaced by fibre extracts of Apple, Orange or Apple+Orange (in equal amounts)(see Table 2). Formulation of treatment diets was based on results of analyses for total dietary fibre of the two fibre extracts. Pigs were fed twice daily, at 0900 and 1600, at a rate proportional to their metabolic live weight (70 g x $LW^{0.75}$). The daily allowance was adjusted weekly when the animals were weighed. Pigs had unrestricted access to water for the duration of study.

Surgical Preparation and Experimental Design

For logistical reasons the study was split into two staggered sub-experiments (7-day overlap).

During the pre-experimental period, pigs were maintained on their regular commercial, pelleted diet for several days, until surgical implantation of a cephalic vein catheter. Pigs were then divided, on the basis of live weight, into 4 groups of six animals each. The remaining four animals were used as reserves. Immediately after surgery pigs were transferred to the Control diet (Day 7). After a further 7 days, three of the groups were randomly assigned to experimental diets, while the fourth group (and the unassigned animals) continued to be fed Control diet. Diets were fed for the remaining 21 days of experiment (days 7 to 28) and, at the end of the feeding period, pigs were anaesthetised in order to allow the designated samples to be collected, and then slaughtered.

Experimental Procedure and Measurements

Catheters were maintained by daily flushing of the dead-space with heparinised saline. Fasting blood samples were taken on 5 occasions (days 1, 7, 14, 21, and 28). The blood sample on Day 28 was taken from the abdominal aorta; all other blood samples were via cephalic vein catheter.

At the completion of the feeding period (day 28, - 21 days after the introduction of treatment diets) and approximately 16 hours after the pigs had been fed the evening before, they were weighed and anaesthetised (intravenous infusion of Pentothal). The abdominal cavity was opened and blood collected from the abdominal aorta, and the GI tract was then ligated and excised, along with the liver. The liver was blot-dried and weighed, and a sample collected and snap-frozen. The small and large bowels were isolated and measured. The colon was divided into three segments of equal length, and the content of each of those segments, and that of the caecum, were extruded, weighed and sub sampled. The colon and caecum, devoid of contents, were blotted dry and weighed.

Small samples of liver and plasma were analysed for cholesterol content using gas chromatography. Digesta was diluted with distilled water for determination of pH and dry matter by standard techniques, and short-chain fatty acids (SCFA), caecal bile acids and neutral sterols by GC procedures.

Data Analysis

Data are shown as the mean and pooled standard error of the mean (SEM), with the number of observations per group as indicated in the tables. Statistical analysis was by one-way analysis - variance (ANOVA) and when significant values were detected (F value $P<0.05$), differences between individual means were then analysed by the PDIFF procedure of SAS. Differences between treatment means are considered significant at

P<0.05. For tabulated results, values within a column with different superscripts differ significantly.

Hepatic and digesta metabolise pools were calculated as:

Concentration (μmol/g or mmol/L) x
weight of liver (g), or
volume of digesta water (mL).

Results

Animal Health

During the pre-experimental period it was necessary to substitute a pig that had become lame for one from the reserve group. The catheters of two pigs in the Apple group ceased to function on about day 14 of the trial and therefore two additional pigs from the reserve group were assigned to this treatment. Consequently, at the time of slaughter, these two animals had been fed the treatment diet for just 14 days. However, as the results for these two animals were not substantially different from others in the group, they were therefore included in subsequent statistical analyses. One pig from the Apple+Orange group was euthanased just prior to completion of the study for reasons of illness (apparently unrelated to diet). During intubation (for catheterisation), several pigs were found to have a throat infection, however this appeared to be a minor ailment and did not affect food consumption or rate of growth,

Food Acceptability and Live Weight Gain

Pigs found the diets acceptable, and there were no indications of overt adverse reactions. Pig growth rate (and feed conversion efficiency) during the period of study was satisfactory (average daily gain was ~500 g/d), and within the range encountered in commercial piggeries. Diet had no significant effect on live weight change during the feeding period (Table 3). The growth rate data is confirmation that there were no serious adverse reactions (eg diarrhoea, gastrointestinal disturbances or nutritional deficiencies) to these diets.

Small and Large Bowel Morphology

Neither intestinal length nor mass were influenced by dietary treatments (Table 4). Caecal and colonic weight were greatest in pigs fed Apple+Orange, however the differences were not statistically significant. Also, there were no differences between treatments for weight of the individual colonic segments (data not shown).

The Apple+Orange diet may have had a stimulatory effect on intestinal growth, as intestinal mass of the small bowel, caecum and colon were each greater numerically than that of any other treatment (but statistically not significant). Given that the colon of this group was about 10% heavier, and slightly shorter in length, than that of the others, it would suggest that the mixed fibre diet may have resulted in a thickening of the colonic wall. It is worth noting that the mixed fibre diet was particularly effective in raising SCFA levels at various sites in the large bowel (see later). These metabolites are potent trophic agents for intestinal mucosa.

Large Bowel Digesta Mass and Water Content

Generally, digesta mass was similar for the four groups (Table 5). Digesta mass of pigs fed wheat bran was greater at each of the large bowel sampling sites, however, these differences reached statistical significance for the mid colon only. Digesta moisture content declined progressively from the caecum through to the distal colon (Table 6). There were no significant treatment differences for this variable in the caecum and proximal colon, however, in the mid colon, water content of digesta in pigs fed Wheat bran was greater than that of the Apple treatment, but not significantly, compared to other treatments. Digesta in the distal colon of pigs given wheat bran contained about 10% more water than that for any of the other dietary treatments.

Similar amounts of wet digesta mass in the caecum of each group suggests that the amount of material entering the large bowel, which is primarily non-absorbed carbohydrate, is similar. For the Wheat bran group, there appears to be a progressive loss of material along the colon, however, for fibre extract treatments, fermentation occurs mainly in the proximal and mid colon. This finding reflects and confirms the highly fermentable nature of the fibre extract products. As large bowel bacteria catabolise fibre, its structure, and hence, water- holding capacity diminishes, along with the contribution that these materials could make to digesta mass and, hence, faecal weight. Although the fibre extracts would be expected to promote growth of enteric bacteria, this activity would occur primarily in the proximal region of the large bowel, and the contribution of expanded bacterial biomass to stool output may not be large. Data for the large bowel is compatible with the finding that the faeces of pigs fed diets containing fibre extracts, compared to Wheat bran, were much firmer, and formed into dense pellets. The apparent "constipating" effects of the fibre extract diets, however, do not appear to have been particularly serious (food intake, for example, was not compromised). Earlier studies have indicated that the optimal water content in digesta and faeces is 70- 80%. Also, because wheat bran is the most effective dietary fibre source for promoting stool weight (and alleviating constipation in human), differences with other fibres in relation to faecal output and consistency are expected.

Large Bowel pH

At each of the intestinal sampling sites, acidic conditions were found in large bowel lumen of those pigs receiving fibre extracts, compared to the Wheat bran. Differences in pH for the individual fibre extract treatments (Table 7) were not significant.

The fermentability of fibre extracts is clearly reflected in the acidic conditions found in the large bowel, especially in the caecum, and to a lesser extent, in the colon. Acidification of luminal contents has desirable health consequences, in that the formation, availability and absorption of various carcinogens and toxic materials in the hindgut is reduced. Indeed, a high pH in the human large bowel is thought to be a risk factor for colorectal cancer.

Large Bowel Short Chain Fatty Acid Concentrations

Generally, concentrations of total SCFA tended to be greatest in the caecum and proximal colon compared to the other sites, and throughout the large bowel, levels of these metabolites were higher in pigs fed fibre extracts (particularly for the diet containing mixed fibres) relative to Wheat bran, although only a few differences reached statistical significance (Table 8). Profiles for each of the individual SCFA were similar (Table 9-11). Compared to Wheat bran, the Apple+Orange treatment produced substantially higher butyrate concentrations in the proximal and distal colon. Total and individual SCFA values for the mixed fibre treatment were (numerically) greater than those values obtained for either Apple or Orange fibre.

The finding that fibre extracts were effective in raising SCFA level is significant because of the purportive role of these metabolites in the prevention and amelioration of important large bowel diseases. The mixed fibre diet was particularly effective in raising butyrate levels throughout the large bowel, especially in the distal colon, which is the site of most bowel disease in humans. The extent to which the level of SCFA and in particular butyrate has increased is quite surprising and is indicative of a synergy that has taken place between the fibre extracts. The exact nature of the synergy is unknown but it is expected that the synergy will also take place between fibre extracts of other fruit and vegetable sources. The effect of continued consumption of the mixed fibre product however is suggested to enhance the bacteria in the large intestine that are capable of producing SCFA and thereby reducing the population of bacteria that lead to adverse health effects.

The fibre extracts used are convenient to handle because they are fermentable in the large bowel, and are not heat labile.

It is thought that the high pectin content of the two fibre extracts used provides a fermentable fibre but the nature of the synergy is not clear at present.

HUMAN FEEDING TRIALS OF FIBRE EXTRACTS

Materials and Methods

Subjects

The study group consisted of 23 volunteers, 12 males and 11 females, aged between 39 and 70 years (mean SEM 51.3 ±1.8 y) and BMI 24.26 ±0.49 kg/m^2.

Diets

The study consisted of a balanced, two-period crossover trial preceded by a baseline (reference) period. Subjects were randomly allocated to either the Wheat bran cereal or the test cereal (PTI fibre) supplement group for 14 days and then assigned to the alternative dietary supplement for the same period of time.

The two dietary supplements were extruded breakfast cereals prepared from digestible starch and either Wheat bran or an orange and apple fibre extract (PTI fibre) as the test fibre. Volunteers were provided with 34 or 45 g daily portions of PTI or Wheat bran cereal, respectively, equivalent to approximately 15 g of dietary fibre. They were asked to consume daily the respective supplements for each of the 2-week intervention periods. Fibre intake was restricted to about 20 g/day during the Baseline (pre-supplementation) period by providing subjects with a low fibre cereal and advising them to avoid designated high fibre foods which they also refrained from eating throughout the study.

Experimental Procedure and Measurements

Stools were collected over a 48-hour period prior to (Baseline) and 2 weeks after commencing each intervention. Faecal specimens were weighed, mixed thoroughly before a subsample of approximately 1 g was taken for estimation of water content. A further subsample of faeces was diluted with a known volume of internal standard, for SCFA determination, and the pH of the slurry determined by insertion of an appropriate electrode. Total and major individual short-chain fatty acid concentrations were measured by gas chromatography.

Data Analysis

Faecal data were analysed as a randomised complete block design by two-way analysis of variance using the General Linear Model procedure of Statistical Analytical Systems. Gender was used as the block. Differences between baseline and dietary treatments were

determined using the protected difference procedure of SAS. Results are presented as least squares means and their pooled standard error (SEM).

Results

Large Bowel pH

Acidic conditions were found in faecal samples before and after receiving fibre extracts (Tables 12, 13). Differences in pH for the extract treatments and the Wheat bran treatment were not significant.

Large Bowel Short Chain Fatty Acid Concentrations

Generally, concentrations of total SCFA tended to higher in subjects fed fibre extracts relative to Wheat bran (Tables 14-17). Profiles for each of the individual SCFA were similar (Tables 14-17).

FORMULATIONS CONTAINING FIBRE EXTRACTS

Breakfast cereal

An example of a food product to which the apple and orange fibre mix, in the proportions set out above might be added is set out below.

A breakfast cereal formulation is as follows:

	Normal	With fibre mixture
Maize flour	91%	77%
Fibre mixture -		14%
Malt	3%	3%
Sugar	5%	5%
Salt	1%	1%

The process of making the corn flake product with fibre mixture is the same as making the cornflake mixture with the normal mix and is in accordance with methods known to the person skilled in the art.

An example of a breakfast cereal to which the carrot and grape fibre mix might be added is as follows:

Carrot fibre	16%
Grape fibre	16%
Wheat or cornflour	21%

Wheat bran	19%
Malt	10%
Sugar	17.2%
Salt	0.8%

An example of a breakfast cereal to which the cranberry and grapefruit fibre mix might be added is as follows:

Cranberry fibre	19%
Grapefruit fibre	13%
Wheat or cornflour	21%
Wheat bran	19%
Malt	10%
Sugar	17.2%
Salt	0.8%

An example of a granola to which the apple and orange fibre mix might be added is as follows:

Rolled oats	30%
Apple fibre	16%
Orange fibre	15%
Crisped Rice	11%
Almonds	8%
Coconut	8%
Gum Arabic	5%
Gum Ghatti	4%
Guar Gum	3%

An example of a fruit juice to which the apple and orange fibre mix might be added is a commercial orange juice (98% juice) to which 3% by weight of the fibre mix is added.

An example of a soup to which the carrot and grape fibre mix might be added is a commercial vegetable soupo mix containing vegetables, meat stock and starch to which is added 8% by weight of the fibre mix.

Various features of the invention have been particularly shown and described in connection with the exemplified embodiment of the invention, however, it must be understood that

these particular arrangements merely illustrate and that the invention is not limited thereto and can include various modifications falling within the spirit and scope of the invention.

CLAIMS

1. A food supplement, said food supplement derived from fibre extracts from two or more types of fruit or vegetables, the fibre extracts having had a majority of soluble solids removed therefrom.

2. A food supplement according to claim 1 wherein greater than 90% of soluble solids are removed.

3. A food supplement according to claim 2 wherein from between 93 to 99% of soluble solids are removed.

4. A food supplement according to claim 1 wherein a first of the two or more types of fruit or vegetables is selected from the group consisting of citrus, tomato, carrot, mango, papaya, banana, pineapple, kiwi fruit, spinach and a second of the two or more types of fruit or vegetables is selected from the group consisting of melon, grape, apple and cranberry.

5. A food supplement according to claim 4 wherein the melon is selected from the group consisting of watermelon, rock melon, honeydew melon or champagne melon.

6. A food supplement according to claim 4 wherein the first of the two or more fruit and vegetables is a citrus fruit or carrot and the second of the two or more fruit or vegetables is selected from the group consisting of grape, apple and cranberry.

7. A food supplement according to claim 6 wherein the first of the two or more types of fruit or vegetables is selected from the group consisting of orange, carrot and grapefruit and the second of the two or more types of fruit or vegetables is selected from the group consisting of grape, apple and cranberry.

8. A food supplement according to claim 1 wherein a first of the two or more fruits or vegetables has a calcium content of between 4000 and 15000 ppm and a second of the two or more fruit or vegetables has a calcium content of between 200 and 1500 ppm.

9. A food supplement according to claim 1 wherein a first of the two or more fruits or vegetables has a soluble neutral non starch polysaccharide content of between 1 and 2 percent dry weight and a second of the two or more fruit or vegetables has a soluble neutral non starch polysaccharides content of between 2 and 3 percent dry weight.

10. A food supplement according to claim 1 wherein a first of the two or more fruits or vegetables has a total uronic acids content of between 5 and 20 percent dry weight and a second of the two or more fruit or vegetables has a total uronic acids content of between 20 and 40 percent dry weight.

11. A food supplement according to claim 1 wherein
the first of the two or more fruits or vegetables has :
a calcium content of between 4000 and 15000 ppm;
a soluble neutral non starch polysaccharides content of between 1 and 2 percent dry weight; and
a total uronic acids content of between 5 and 20 percent dry weight
and the second of the two or more fruit or vegetables has :
a calcium content of between 200 and 1500 ppm;
a soluble neutral non starch polysaccharides content of between 2 and 3 percent dry weight; and
a total uronic acids content of between 20 and 40 percent dry weight.

12. A food supplement according to claim 11 wherein the first of the two or more fruit and vegetables is an orange, and the second of the two or more fruit or vegetables is selected from the group consisting of apple, grape and cranberry.

13. A food supplement according to claim 12 wherein the first of the two or more fruit and vegetables is an orange and the second of the two or more fruit or vegetables is an apple.

14. A food supplement according to claim 11 wherein the first of the two or more fruit and vegetables is a carrot, and the second of the two or more fruit or vegetables is selected from the group consisting of apple, grape and cranberry.

15. A food supplement according to claim 14 wherein the first of the two or more fruit and vegetables is a carrot, and the second of the two or more fruit or vegetables is a grape.

16. A food supplement according to claim 11 wherein the first of the two or more fruit and vegetables is a grapefruit, and the second of the two or more fruit or vegetables is selected from the group consisting of apple, grape and cranberry.

17. A food supplement according to claim 16 wherein the first of the two or more fruit and vegetables is a grapefruit, and the second of the two or more fruit or vegetables is a cranberry.

18. A food product having the food supplement of any one of claims 1 to 17.

19. A food product according to claim 18 wherein the food product contains between 1 and 50 % by weight of the food supplement.

20. A food product according to claim 19 wherein the food product contains between 1 and 30% by weight of the food supplement.

21. A food product according to claim 20 wherein the food product is a breakfast cereal.

22. A food product according to claim 20 wherein the food product is a granola bar.

23. A food product according to claim 20 wherein the food product is a soup that contains between 2 and 15% of the food supplement

24. A food product according to claim 20 wherein the food product is a beverage that contains between 2 and 5 % of the food supplement.

25. A method of preparing a food supplement derived from fibre extracts from two or more types of fruit or vegetables, the method including the steps of removing a majority of the soluble solids from each of the two or more types of fruit or vegetables separately to give fibre extracts from the two or more fruits or vegetables, and combining the fibre extracts to provide the food supplement.

26. A method of preparing a food supplement according to claim 25 wherein greater than 90% of soluble solids are removed.

27. A method of preparing a food supplement according to claim 26 wherein from between 93 to 99% of soluble solids are removed.

28. A method of preparing a food supplement according to one of claims 25 or 27 wherein each of the two or more fruits or vegetables is sliced so as to substantially minimise breakdown of the structure of macromolecules forming the fibres.

29. A method of preparing a food supplement according to claim 26 wherein the method includes the step of inactivating enzymes within the fruit or vegetables.

30. A method of preparing a food supplement according to claim 29 wherein the step of inactivating enzymes is by heat inactivation.

31. A method of preparing a food supplement according to claim 30 wherein the majority of soluble solids are removed by liquid extraction.

32. A method of preparing a food supplement according to claim 31 wherein the extraction liquid is selected from the group consisting of water, chloroform, hexane, chlorinated hydrocarbons, acetone or ethanol.

33. A method of preparing a food supplement according to claim 32 wherein the extraction liquid is water.

34. An agent for increasing levels of one or more fatty acids to the colon of an animal or human, said agent derived from fibre extracts from two or more types of fruit or vegetables, the fibre extracts having had a majority of soluble solids removed therefrom.

35. An agent for increasing levels of one or more fatty acids to the colon of an animal or human according to claim 34 wherein the increase in levels of fatty acid in the colon is greater than the level afforded by any one of the fruits or vegetables alone.

36. An agent for increasing levels of one or more fatty acids to the colon of an animal or human according to claim 35 wherein the fatty acid is a short chain fatty acid.

37. An agent for increasing levels of one or more fatty acids to the colon of an animal or human according to claim 36 wherein a first of the two or more types of fruit or vegetables is selected from the group consisting of citrus, tomato, carrot, mango, papaya, banana, pineapple, kiwi fruit, spinach and a second of the two or more types of fruit or vegetables is selected from the group consisting of melon, grape, apple and cranberry.

38. An agent for increasing levels of one or more fatty acids to the colon of an animal or human according to claim 37 wherein the first of the two or more fruit and vegetables is a citrus fruit or carrot and the second of the two or more fruit or vegetables is selected from the group consisting of grape, apple and cranberry.

39. An agent for increasing levels of one or more fatty acids to the colon of an animal or human according to claim 38 wherein the first of the two or more types of fruit or vegetables is selected from the group consisting of orange, carrot and grapefruit and the second of the two or more types of fruit or vegetables is selected from the group consisting of grape, apple and cranberry.

TABLE 1
Relative compositions of selected fruits and vegetables

	Fruit 1			*Fruit 2*		
Component	Apple	Grape	Cranberry	Orange	Grapefruit	Carrot
Calcium (ppm)	1434	500-1000	319	10071	10000	4309
Potassium (ppm)	3518	7000	1750	1821	1800	7794
Soluble NNSP (% dry wt.)	1.43	1.30	1.5	2.23	2.25	2.19
Total NNSP (% dry wt.)	29.91	29-30	30.0	29.98	30.0	29.17
Soluble uronics (% dry wt.)	10.0	5.0	5.0	14.0	14.0	6.7
Total uronics (% dry wt.)	16.8	9.0	10.0	31.9	32.0	21.1
Lignin (% dry wt.)	24.0	24.0	24.0	25.0	25.0	18.6

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TABLE 2
Composition of experimental diets (g/kg)

Ingredient	Control	Apple	Orange	Apple+Orange
Casein	160	143	144	143
Starch	497	497	497	497
Sugar	100	53	58	55
Palm oil	130	188	188	188
Safflower oil	20	20	20	20
Wheat bran	75	-	-	-
Apple extract	-	106	-	53
Orange extract	-	13.3	96	48
Dicalcium phosphate	13.3	13.3	13.3	13.3
Minerals (other)	3.2	3.2	3.2	3.2
Vitamins	1.5	1.5	1.5	1.5

TABLE 3
Initial and final live weight, and live weight gain of pigs

Dietary group	Live Weight		Live Weight Gain
	Initial	Final	
		kg	
Wheat bran	31.6	48.1	16.5
Apple	31.8	46.1	14.2
Orange	33.2	47.8	14.6
Apple+Orange	33.5	48.7	15.2
SEM	1.3	1.8	1.0

Values are means for 7, 8, 6 and 5 observations for treatments Wheat bran, Apple, Orange and Apple+Orange, respectively.
Treatment differences are not statistically significant ($P<0.05$).

09/647882
PCT/AU99/00273

TABLE 4
Morphology of the small and large bowel

Dietary group	Small Intestine	Caecum		Colon	
	Length	Weight	Length	Weight	Length
	m	g	cm	g	m
Wheat bran	15.29	95.9	16.7	568	2.97
Apple	15.15	101.5	15.6	550	2.84
Orange	14.65	89.7	14.8	547	2.81
Apple+Orange	15.32	109.8	15.2	613	2.77
SEM	0.51	9.4	1.0	34	0.12

Values are means, with number of observations as per Table 5.

09/647882
PCT/AU99/00273

TABLE 5
Wet weight of digesta in the large bowel

Dietary Group	Caecal	Proximal colon	Mid colon	Distal colon	Total colon
			g		
Wheat bran	152	349	216[a]	154	871
Apple	135	252	117[c]	107	611
Orange	169	274	118[b]	81	642
Apple+Orange	143	243	129[b]	112	627
SEM	37	39	27	22	90

Values are means, with number of observations as per Table 2. Means in the same column with different superscript letters differ ($P<0.05$). [a-b], $P<0.05$, [a-c], $P<0.01$.

TABLE 6
Water content of digesta in the large bowel

Dietary Group	Caecal	Proximal colon	Mid colon	Distal colon
			%	
Wheat bran	88	84.4	79.8[a]	73.2[a]
Apple	90.4	83.6	74.5[b]	63.2[c]
Orange	88.4	82.1	76.5	63.9[c]
Apple+Orange	91.0	84.0	76.0	62.8[c]
SEM	2.1	2.0	2.0	2.0

Values are means, with number of observations as per Table 5. Means in the same column with different superscript letters differ [a-b], $P<0.05$; [a-c], $P<0.01$.

TABLE 7
pH of digesta in the large bowel

Dietary Group	Caecal	Proximal colon	Mid colon	Distal colon
Wheat bran	7.13[a]	7.10[a]	7.21[a]	7.09[a]
Apple	5.84[d]	6.18[d]	6.24[d]	6.29[d]
Orange	5.84[d]	6.09[d]	6.14[d]	6.28[d]
Apple+Orange	5.85[d]	6.06[d]	6.06[d]	6.05[d]
SEM	0.16	0.11	0.13	0.13

Values are means, with number of observations as per Table 2. Means in the same column with different superscript letters differ [a-b], $P<0.05$; [a-c], $P<0.01$, [a-d], $P<0.01$.

TABLE 8
Concentration of total SCFA in the large bowel

Dietary Group	Caecal	Proximal colon	Mid colon	Distal colon
		mmol/L		
Wheat bran	62.8	60.5[a]	53.1	55.4
Apple	68.3	71.1[a]	55.4	43.7
Orange	75.5	79.9[ac]	67.6	42.5
Apple+Orange	88.2	93.3[c]	76.3	61.7
SEM	15.7	7.3	8.3	6.7

Values are means, with number of observations as per Table 2. Means in the same column with different superscript letters differ: [a-c], P<0.01.
For the Proximal colon, Wheat bran vs Orange, P=0.07; for Mid colon and Distal colon, ANOVA F value not significant.
For Mid colon, Wheat bran vs Apple+Orange, P=0.073; Apple vs Apple+Orange, P=0.095. For Distal colon, Apple+Orange vs Apple, P=0.074, Apple+Orange vs Orange, P=0.074.

TABLE 9
Concentration of total acetate in the large bowel

Dietary Group	Caecal	Proximal colon	Mid colon	Distal colon
		mmol/L		
Wheat bran	40.8	38.6a	33.7	35.2
Apple	43.0	42.4[bc]	33.3	27.0
Orange	48.6	48.5	39.6	26.6
Apple+Orange	59.2	60.1[c]	46.2	36.7
SEM	10.2	4.8	5.3	4.2

Values are means, with number of observations as per Table 2.
Means in the same column with different superscript letters differ: [a-b], P<0.05; [a-c], P<0.01.

TABLE 10
Concentration of propionate in the large bowel

Dietary Group	Caecal	Proximal colon	Mid colon	Distal colon
		mmol/L		
Wheat bran	17.3	15.7	12.0	12.6
Apple	19.5	19.6	12.9	8.38
Orange	21.2	22.6	18.1	8.73
Apple+Orange	21.2	22.7	19.1	11.9
SEM	4.4	2.3	2.7	1.7

Values are means, with number of observations as per Table 2.
ANOVA F value not significant.
For Mid colon, Wheat bran vs Apple+Orange, P=0.085.
For Distal colon, Wheat bran vs Apple, P=0.076.

TABLE 11
Concentration of butyrate in the large bowel

Dietary Group	Caecal	Proximal colon	Mid colon	Distal colon
		mmol/L		
Wheat bran	4.74	6.06	7.43	7.67[a]
Apple	5.83	9.15	9.20	8.28[a]
Orange	5.73	8.80	9.90	7.13[a]
Apple+Orange	7.80	10.4	11.0	13.0[b]
SEM	1.62	1.1	1.4	1.4

Values are means, with number of observations as per Table 2. Means in the same column with different superscript letters differ: ANOVA F value not significant for Caecum, Proximal and Mid colon. For Proximal colon, Wheat bran vs Apple, P=0.052.

PCT/AU99/00273

TABLE 12

Faecal pH, moisture content, and wet and dry weight in volunteers before and after dietary supplementation1

Period & Measurement2	Dietary Treatment			Pooled sem3
	Baseline	Fruit-fibre product	Wheat bran cereal	
pH	6.91	6.76	6.81	0.10
Wet weight (g)	260a	337b	347b	25
Moisture content (%)	26.7	25.1	25.7	1.3
Dry weight (g)	64.9a	79.5b	85.4b	5.2

1Data were analysed as completely randomised design using analysis of variance. Means separation was by protected difference option of SAS. Values are least squares means for 23 observations.

2Faecal samples were collected over two consecutive days immediately prior to (Baseline) and after 4 weeks of dietary treatment.

3Pooled standard error of least squares means (SEM).

a-bP<0.05. For faecal dry weight, Baseline vs Wheat bran, P = 0.007.

TABLE 13

Faecal pH, moisture content, and wet and dry weight in male and female volunteers before and after dietary supplementation1

Period & Measurement2	Dietary Treatment			Pooled sem3
	Baseline	Fruit fibre product	Wheat bran cereal	
pH				
Male	6.96	6.74	6.70	0.14
Female	6.85	6.79	6.92	0.15
Wet weight (g)				
Male	296a	416b	408b	36
Female	225	258	286	35
Moisture content (%)				
Male	23.5	23.5	24.6	1.8
Female	29.9	26.6	26.7	1.9
Dry weight (g)				
Male	68a	95b	100b	7
Female	61	64	71	7

1Data were analysed as completely randomised design using two-way analysis of variance. Means separation was by protected difference option of SAS. Values are least squares means for 12 female and 13 male volunteers.

2Faecal samples were collected over two consecutive days immediately prior to (Baseline) and after 4 weeks of dietary treatment.

3Pooled standard error of least squares means (SEM).

09/647882 PCT/AU99/00273

TABLE 14

Faecal short chain fatty acid (SCFA) concentrations and molar ratios weight in volunteers before (Baseline) and after dietary supplementation1

Period & Measurement2	Dietary Treatment			Pooled sem3
	Baseline	Fruit-fibre product	Wheat bran cereal	
	Faecal SCFA concentration (mM)			
Acetate	47.4	58.5	51.1	4.9
Propionate	13.5	15.7	13.5	1.3
Butyrate	16.7	19.9	17.9	2.3
Total SCFA	77.6	94.1	82.4	8.2
SCFA molar ratio (A:P:B)4	61:18:22	63:17:20	63:17:20	-

1Data were analysed as completely randomised design using analysis of variance. Means separation was by protected difference option of SAS. Values are least squares means for 23 observations.

2Faecal samples were collected over two consecutive days immediately prior to (Baseline) and after 4 weeks of dietary treatment.

3Pooled standard error of least squares means (SEM).

TABLE 15

Faecal short chain fatty acid (SCFA) concentrations and molar ratios weight in male and female volunteers before (Baseline) and after dietary supplementation1

Period & Measurement2	Dietary Treatment			Pooled sem3
	Baseline	Fruit fibre product	Wheat bran cereal	
	Faecal SCFA concentration (mM)			
Acetate				
Male	42.2a	61.6b	53.8	6.8
Female	52.7	55.5	48.5	7.1
Propionate				
Male	12.7	17.0	13.9	1.9
Female	14.7	14.3	13.0	1.9
Butyrate				
Male	16.2	17.3	16.6	3.3
Female	17.2	22.5	19.1	3.2
Total SCFA				
Male	72.0	101.1	86.8	11.3
Female	83.3	87.1	78.0	11.8
SCFA molar ratio (A:P:B)4				
Male	58:19:24	61:17:22	62:17:21	-
Female	64:17:19	65:17:18	64:17:20	-

1Data were analysed as completely randomised design using two-way analysis of variance. Means separation was by protected difference option of SAS. Values are least squares means for 12 female and 13 male volunteers. 2Faecal samples were collected over two consecutive days immediately prior to (Baseline) and after 4 weeks of dietary treatment. 3Pooled standard error of least squares means (SEM). For propionate concentration: Baseline vs PTI product, P = 0.103 for male volunteers. For total SCFA concentration: Baseline vs PTI product, P = 0.073 for male volunteers.

TABLE 16

Faecal short chain fatty acid (SCFA) excretion in volunteers before (Baseline) and after dietary treatments1

Period & Measurement2	Dietary Treatment			Pooled sem3
	Baseline	Fruit fibre product	Wheat bran cereal	
	Faecal SCFA excretion (mmol)			
Acetate	9.91a	16.44b	14.10	2.10
Propionate	2.85	4.36	3.72	0.56
Butyrate	3.63	5.89	5.13	0.97
Total SCFA	16.38a	26.69b	22.95	3.54

1Data were analysed as completely randomised design using analysis of variance. Means separation was by protected difference option of SAS. Values are least squares means for 23.

2Faecal samples were collected over two consecutive days immediately prior to (Baseline) and after 4 weeks of dietary treatment.

3Pooled standard error of least squares means (SEM).

a-bP<0.05. For propionate and butyrate excretion: Baseline vs PTI product, P = 0.060 and 0.105, respectively.

TABLE 17

Faecal short chain fatty acid (SCFA) excretion in male and female volunteers before (Baseline) and after dietary treatments1

Period & Measurement2	Dietary Treatment			Pooled sem3
	Baseline	Fruit fibre product	Wheat bran cereal	
	Faecal SCFA excretion (mmol)			
Acetate				
Male	10.11a	21.02b	16.82	2.91
Female	9.70	11.86	11.38	3.04
Propionate				
Male	3.02a	5.62b	4.38	0.77
Female	2.68	3.10	3.06	0.81
Butyrate				
Male	4.36	8.15	6.24	1.35
Female	2.90	3.64	4.02	1.41
Total SCFA				
Male	17.48a	34.79b	27.45	4.89
Female	15.29	18.59	18.46	5.11

1Data were analysed as completely randomised design using two-way analysis of variance. Means separation was by protected difference option of SAS. Values are least squares means for 23.

2Faecal samples were collected over two consecutive days immediately prior to (Baseline) and after 4 weeks of dietary treatment.

3Pooled standard error of least squares means (SEM).

a-bP<0.05.

For butyrate excretion: Baseline vs PTI product, P = 0.051 for male volunteers.